Field Notes

San Joaquin County
May 2019

University of California
Agriculture and Natural Resources

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Livestock's Impact on Greenhouse Gases

With Earth Day just behind us in April, I thought I would include a discussion here about greenhouse gases and livestock production. There has been much discussion lately on the topic, with different perspectives.

Livestock's Long Shadow was released in 2006 and stated that livestock produced more greenhouse gases than transportation worldwide. It shocked and outraged many involved in livestock production, including University of California Air Quality Specialist, Frank Mitloehner. His research, starting with dairy cattle, has shown a much smaller percent of greenhouse gases coming from cattle. Jokingly referred to as "cow farts", it is actually "cow belching". Yes, ruminant animals (cattle, sheep, goats, deer, bison, elk, etc.) have a fermentation vat for their digestive system, which allows them to consume low quality forages and create a nutritional product for us (meat and milk), but methane is produced in the process and "belched" to release that gas from the animal's digestive tract. However, the amount of gas is much smaller than what was calculated for *Livestock's Long Shadow*. Dr. Mitloehner also faulted the report for comparing the entire production cycle for livestock but only tail pipe emissions for transportation, ignoring the emissions associated with the production of vehicles. The author did acknowledge his flaws; yet, *Livestock's Long Shadow* still has a shadow over animal production thirteen years later. Here are some facts, stemming from Dr. Mitloehner's research, to help put things in perspective.

In California, 8% of the state's greenhouse gas emissions are from agriculture, and 80% of emissions are from transportation, electricity, and industry. Out of the 8%, 4% is from all of livestock production. Other researchers have calculated the impact of the entire US population becoming vegan and what that would mean for our greenhouse gas emissions – 2.6%. Another way to look at it, as Dr. Mitloehner puts it, if we become vegan for a year, the savings in greenhouse gas emissions would be equivalent to a one-way flight from San Francisco to London. US and California producers are very efficient and have continually made improvements in pounds of production per animal, improved breeding, improved health, etc. The US produces more beef than any other country, all while producing fewer greenhouse gas emissions.

Only looking at emissions also takes a very simplistic view of the big picture. Livestock production, especially in California, provides a vital role in many ecosystem services. Cattle grazing on rangelands can help sequester carbon on grazed lands; manure is often used in organic farming as the main fertilizer. Another vital role livestock play is in upcycling by-products from other ag sectors such as almond hulls, tomato pumice, rice bran, cottonseed and distillers grain. Many of the by-products from the Impossible Burger find their way into animal agriculture as feed, such as soybean hulls. In addition, cattle grazing—the number one land use in California—not only reduces fuel loads and can minimize greenhouse gas emissions from catastrophic wildfires, but it also supports habitat for many of California's threatened and endangered species, such as California Tiger Salamander. The research shows that it is too simplistic to suggest that reducing meat consumption is a climate smart lifestyle strategy.

We should all contribute to reducing our environmental impact on the planet by making climate-friendly choices, but being smart about climate-smart strategies means applying research-based knowledge to understand where our choices make a real difference.

Theresa Becchetti, Livestock and Natural Resources Advisor, Stanislaus and San Joaquin counties

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Bacterial Blossom and Leaf Blast and Canker of Almond Trees

I observed a number of almond orchards this spring where the fruit and vegetative buds pushed, but the blossoms and growing shoot tips quickly blighted with bacterial blast-like symptoms (Figure 1). This was followed by blighted leaves (Figures 2-3), with a number of trees showing full bacterial canker symptoms (Figure 4) that I worry will not survive. Bacterial canker and blossom and bud blast are both caused by the plant pathogenic bacteria called *Pseudomondas syringae pv. syringae* that is usually found living on the surface of healthy plants.

Figure 1. Blossom blast.

Figure 2. Blossom and leaf blast.

Pseudomondas syringae lives most of the time as an 'omnipresent epiphyte,' always present on the surface of plants. It lives there happily, just waiting for certain environmental conditions (i.e. cold and wet) that allow it to enter the plant, multiply, and build to high enough populations within the tree to trigger a disease (i.e. bacterial blast or canker). Relatively little is known about blossom bacterial blast, but we do know that cold, wet weather can be important predisposing factors that can worsen the disease. The picture of blasted flowers are from trees growing in

Figure 3. Bacterial blast on leaf.

sandy soils in an orchard near Manteca. During almond bloom, we had some freezing temperatures and wet weather. Bacterial blast is usually more severe in the lower canopy of the tree and in the lower part of an orchard. Blast is usually more severe on earlier blooming varieties, but that may be because earlier blooming varieties tend to be in bloom when temperatures are cooler. Aldrich and Fritz seemed much less affected than Nonpareil, Independence, or Carmel. Bacterial blossom blast has been significantly reduced in trials where trees were protected against frost by running water or wind machines. Harley English, a UC Davis professor in the 1980s, conducted a series of experiments on bacterial blossom blast. Cut blossoming shoots of almond that were subjected to 24.8 °F (-4°C) for two hours were significantly more susceptible to blast than shoots that were not subjected to the two-hour frost treatment. In another experiment, cut leafing out shoots were sprayed with 'ice-nucleating' (i.e. the ability to catalyze the formation of ice) *Pseudomondas syringe* before being subjected to freezing temperatures. Other shoots were also inoculated but not chilled. Damage to leaf clusters were significantly greater in shoots that had been inoculated and chilled, confirming the interaction between ice-nucleating bacteria and freezing temperatures with bacterial blast.

Figure 4. Bacterial canker.

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Symptoms of bacterial canker can be observed in the spring and include scaffold and trunk dieback with cankers and amber-colored gum. Sometimes total tree collapse can occur. The sour-sap phase of bacterial canker may not show gum and cankers, but the inner bark can be brown, fermented, and sour smelling. Flecks and pockets of bacterial invasion in bark occur outside canker margins (Figure 5). Frequently, trees sucker from below the graph union because bacterial canker does not move into the rootstock.

Figure 5. Bacterial canker red flecks on bark.

Trees growing in sandy soils with high ring nematode populations and low nutrient value, typically flood irrigated with district water, appear to be the most susceptible to bacterial canker. Bacterial canker control usually includes preplant fumigation for ring nematode, proper rootstock selection, proper irrigation and nutrition (especially nitrogen and perhaps calcium and iron), and post-plant nematicide treatments (less successful—Movento and VelumOne). Conversion to drip irrigation systems has, in general, reduced bacterial canker incidence. Roger Duncan, UC Farm Advisor in Stanislaus County, has shown Viking and Lovell rootstocks to be more tolerant than peach-almond hybrids (Hansen, Nickels, and Brights) and Nemaguard. Roger also cooperated on research that showed copper sprays may also play an important role at reducing bacterial populations. Silicone-based surfactants may help deliver bactericides into previously inaccessible leaf surfaces. There is limited evidence that defoliating leaves in the fall with zinc or urea may improve bacterial canker symptoms.

Last month, I observed a couple of orchards planted on heavy ground, most likely absent of nematodes, that had trees dying from bacterial canker. Instead of trees being stressed from sandy soils and ring nematodes, I believe these trees were stressed from saturated soils and high salinity conditions. One orchard was in the Delta with leaf tissue analysis showing high sodium levels, while the other was an orchard that received dairy lagoon water over the winter. Stress can induce bacterial canker on almond.

I will be on sabbatical leave from May 1, 2019 through February 29th, 2020, working on whole orchard recycling papers and projects at home, UC Davis, and the Kearney Research and Extension Center. While I am on leave, Emeritus Advisor Paul Verdegaal (209-953-6119) will take phone calls from clientele in San Joaquin County. Roger Duncan (209-525-6800), Pomology Farm Advisor in Stanislaus County, will help Paul if needed. Dr. Michelle Leinfelder-Miles and Karrie Reid, our Delta Crops and Environmental Horticulture Advisors, will share Interim County Director responsibilities of the University of California Cooperative Extension in San Joaquin County (209-953-6100).

Brent Holtz, Farm Advisor and County Director

Impact of Warm-season Legume Cover Crop on Soil Properties

We are getting prepared for our second year of a three-year project evaluating a warm-season legume cover crop between winter small grain crops. We are conducting the trial in a commercial field on Staten Island in the Delta. We are comparing soil health characteristics, greenhouse gas emissions, and grain yields between the cover crop treatment and the standard dry fallow. While cover cropping, particularly in the warm-season, is not a typical management practice in the annual crop rotations of the Delta, it is a management practice identified in the Healthy Soils Program of the California Department of Food and Agriculture as having the potential to improve soil health, sequester carbon, and reduce greenhouse gas emissions. This article describes the soil results from the first year of cover cropping (2018 season).

Methods: The trial is a randomized complete block design (approximately 4.5 acres) with three replicates of each treatment. The soil type across the trial is a Valdez silt loam. Baseline soil samples were collected in July 2018 following wheat harvest but prior to tillage. Soil was sampled from 0-6, 6-12, 12-24, and 24-36 inch depths. On July 30, 2018, a cowpea cover crop (*Vigna unguiculata* cv. 'Red Ripper', Figure 1 on next page) was inoculated with *Rhizobium* and planted after a pre-irrigation. Pre-irrigation was only applied to the cover crop plots. The cover crop was drill-seeded at 7-in row spacing with a planting density of approximately 50 pounds of seed per acre. A second irrigation was applied approximately one month after planting. End-of-season soil sampling (0-6 and 6-12 inch depths) occurred on October 23, 2018, prior to cover crop termination. Soil properties of interest include bulk density, soil moisture, salinity, pH, total nitrogen (N), and total carbon (C). Soil properties were analyzed by the following methods: pH from the soil saturated paste, salinity by the saturated paste extract, and total N and C by combustion method.

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Figure 1. *Vigna unguiculata* cv. 'Red Ripper' cover crop with some volunteer wheat.

Preliminary Results: Soil properties are presented for the baseline condition (Table 1) and for the end of the first cover cropping season (Table 2 on the next page). Bulk density averaged 1.0 g/cm^3 across sample timings, depths, and treatments. Soil moisture (% by volume) was observed to increase from the baseline condition in the cover crop ("CC") treatment. At baseline sampling, salinity increased with depth from 0.47 to 2.44 dS/m. After one cover cropping season, salinity increased in both treatments, but increased more in the no cover crop ("No CC") treatment, averaging 1.22 dS/m from 0 to 12 inches. Soil was acidic, which is typical for the region. The pH averaged 5.5 across sample timings, depths, and treatments, but there may be a trend for cover cropping to increase the pH. Total N and C decreased with depth at the baseline sampling. After one cover cropping season, there was little change from the baseline condition for both properties.

Summary: The Delta is a unique agricultural region with unique environmental challenges. Some soils in the region are subsided due to oxidation of organic matter, and some soils suffer from salinity, having limited ability to leach salts due to low permeability soils and shallow groundwater. Cover cropping is not a typical practice in the annual crop rotations of the region, and summer cover cropping is particularly rare. After the first year of a three-year study, cover cropping had no observed effect on bulk density, Total N, and Total C. Cover cropping may have slightly raised the pH in the top 12 inches, compared to dry fallow. The cover crop treatment, having received two irrigations, had lower salinity in the upper layers of soil compared to dry fallow. We also observed that the 2018-2019 triticale crop that was planted in the field following cover crop termination germinated roughly five days earlier in the cover crop plots compared to the fallowed plots. Thus, it appears that summer cover cropping with a legume has the potential to improve soil tilth at a time of year when the soil would otherwise be fallowed and dry with no soil cover, and there could be agronomic benefits to subsequent crops. We will continue to monitor these soil properties in 2019 and 2020, and additionally, we will monitor small grain yields and greenhouse gas (CH_4, N_2O) emissions.

We would like to thank Dawit Zeleke and Morgan Johnson (Staten Island), Tom Johnson (Kamprath Seed), and Margaret Smither-Kopperl and Valerie Bullard (USDA-NRCS) for their cooperation on this trial. We would like to acknowledge the California Climate Investments program for funding, and our UC colleagues who are cooperating on this grant in other parts of the state (Jeff Mitchell, Will Horwath, Veronica Romero, Sarah Light, Amber Vinchesi-Vahl, and Scott Stoddard).

Michelle Leinfelder-Miles, Delta Farm Advisor
Brenna Aegerter, Vegetable Crops Advisor

Table 1. Soil properties at baseline sampling (July 2, 2018).

Depth (in)	Bulk Density (g/cm^3)	Soil Moisture (% by vol.)	Salinity (EC_e)	pH	Total N (%)	Total C (%)
0-6	1.01	0.13	0.47	5.39	0.27	3.47
6-12	0.97	0.17	0.62	5.32	0.25	3.06
12-24	1.06	0.22	1.29	5.7	0.17	2.01
24-36	1.02	0.26	2.44	5.9	0.10	1.06

Table 2. Soil properties after one season of cover cropping (October 23, 2018). Data represent the mean of three replicates. CC = summer cover cropped with cowpea. No CC = standard summer dry fallow.

Treatment	Depth (in)	Bulk Density (g/cm^3)	Soil Moisture (% by vol.)	Salinity (EC_e)	pH	Total N (%)	Total C (%)
No CC	0-6	0.96	0.08	1.05	5.32	0.27	3.39
No CC	6-12	0.92	0.13	1.39	5.29	0.23	2.97
CC	12-24	0.90	0.23	0.60	5.49	0.27	3.42
CC	24-36	1.06	0.26	0.67	5.47	0.23	2.89

Announcements / Calendar of Events

UC Davis Small Grains and Alfalfa/ Forages Field Day

Wednesday, May 15, 2019
8:00 am — 4:30 pm (includes lunch)
UC Davis Agronomy Field Headquarters
2400 Hutchinson Drive
Davis, CA. 95616
For more information, please contact:
Michelle Leinfelder-Miles, 209-953-6100,
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UC Davis Weed Day

Thursday, July 11, 2019
7:30 am — 4:30 pm (includes lunch)
Buehler Alumni Center, UC Davis
For more information and to register, please visit:
https://wric.ucdavis.edu/events/weed_day_2019.html

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