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Gary Bender

Editor for this issue of Topics in Subtropics

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Vole Damage in Citrus Revisited

Neil O'Connell

Since the first publication of this article on vole damage in citrus, a recent field observation regarding vole activity is worth noting. Voles prefer a situation where there is cover and shelter generally from weed or grass. In some orchards established in the last few years a plastic strip has been installed along the tree row for weed management (Fig 1). These strips appear to be offering a sheltered environment for vole activity in some cases (Fig 2). Recent observations in two such installations, one a block planted in 2013 and the other an eight year old planting exhibited significant vole activity. The young orchard at this point does not exhibit obvious tree damage although active tunneling is apparent (Fig 3). In the older orchard feeding damage to the trunks is very obvious (Fig 4).

Meadow Mice (Voles) can cause serious damage in a citrus orchard resulting in partial or complete girdling of a tree (Fig 5). Trees often exhibit damage to the bark of the tree from the soil line up 6-8 inches (Fig. 6). On close inspection, an open hole 1-1.5 inches in diameter may be found at the base of the tree (Fig 7).

Five species belonging to the genus *Microtus* are found in California, two of which "*Microtus californicus*" and "*M. montanus*" are reported to cause damage. Damage has been reported in permanent pasture, alfalfa, hay, artichokes, Brussels sprouts, carrots, cauliflower, potatoes, sugar beets, tomatoes, grains, nursery stock and the bark of apple, avocado, citrus, cherry and olive trees.

Microtus are often found where there is grass cover. They generally do not invade cultivated crops until the crop is tall enough to provide food and shelter. Meadow mice are active all year round. They forage at any time during the day or night but are chiefly nocturnal. They are usually found in colonies marked by numerous 2--inch wide surface runways though matted grass. Small brownish fecal pellets and short pieces of grass stems along the runways are evidence of activity. The burrows consist of extensive underground tunnels, nest chambers and storage chambers. Home range is typically small, less than a 60 foot radius in the case of "*M. californicus*". All meadow mice swim well. Therefore, irrigation ditches will not serve as effective barriers against meadow mice movement into fields. Meadow mice may forage beyond the sheltered runways. Food consists of tubers, roots, seeds, grain, and succulent stems and leaves.

Females breed at 4 to 6 weeks of age with litter size of "*M. californicus*" averaging around 4. Under natural conditions a female *Microtus* may produce from 5 to 10 litters a year. The major breeding season corresponds with the season of forage growth. *Microtus* populations build up to a peak every 3 to 4 years, followed by a rapid decline during the next breeding season. The exact causes of the cycle of buildup and decline are not known, though disease, food shortages, physiological stress from overcrowding, and other factors may be involved. It is assumed that in cultivated areas *Microtus* populations are permanently based in favorable habitat such as roadsides, canal banks or adjacent noncultivated land. Invasion of cultivated cropland occurs when the population builds up or when the wild habitat becomes unfavorable. Coyotes, badgers, weasels, snakes, hawks, owls, herons and gulls are among the principal predators. It is believed that predators are not able to prevent or control a population eruption because of the birth rate of the fast breeding *Microtus* population. Meadow mice are classified as nongame mammals by the California Fish and Game Code. Nongame mammals, which are found to be injuring growing crops may be taken at any time or in any manner by the owner/management. The most effective management options in an orchard situation are a reduction in ground cover and the use of toxic baits. Meadow mice are cover dependent. In situations where cover removal is not possible or is insufficient to solve the problem, the next best option is the use of toxic baits. Many bait carriers are used (e.g., oat groats, wheat bait). Baits: Crimped oat groats are the most satisfactory bait although crimped whole oats are used (e.g., oat groats, wheat grains, pelletized formulations, etc., but crimped oat groats have typically been most effective). The primary toxicants used for meadow mouse control include zinc phosphide, diphacinone, and chlorophacinone. Directions for management including baiting can be obtained by contacting the Agricultural Commissioner's Office. * Portions taken from J.P. Clark Vertebrate Pest Control



Figure 1 Plastic Cover on Tree Row



Figure 2 Entrance to Vole Tunnel



Figure 3 Extensive Vole Tunneling



Figure 4 Damage



Figure 5 *Microtus* spp.



Figure 6 Bark Damage



Figure 7 Entrance to Vole Chamber



Time to go Fishing!

Gary Bender

After a 30-year career as the farm advisor of subtropical fruit crops in San Diego County, I've decided to retire to do some other things, including some fishing. According to my wife, that seems to mean some painting, re-tiling the floor, re-landscaping and cabinet work. I'm not sure we are speaking the same language!

First, I'd like to thank all of the really great growers in this county. When I first started I knew a lot about dry root rot of citrus (since that was my research topic in college) and quite a bit

about avocado root rot. And I had a pretty good background in diseases and other problems that bother plants. But not much else! I learned a lot about irrigation, frost protection, gopher control etc. from growers and the extension specialists. I even learned how to turn on wind machines and light orchard heaters at 3:00 am from grower John Hankey in Pauma Valley.

Prior to being a farm advisor, I spent four years in grad school at UC Riverside under Dr. John Menge. And he was a great mentor. He understood how important field research was for growers to be successful and he encouraged me to go into extension work.

Prior to getting my Ph.D. in plant pathology I worked one year for the Riverside County Ag Dept, four years for the Orange County Ag Dept as a plant pathology technician and 3 years as a staff research associate at UC Riverside in Entomology, Nematology and Plant Pathology. Oddly enough, it was the Riverside County job that changed the course of my career. I was a floating “problem solver” that basically diagnosed diseases and other problems for growers and homeowners and I got to drive to the calls in a really fast car turned in by the retired sheriff. And I did such a good job I got a “promotion” to being in charge of all the fruit fly trapping from Indio out to Blythe. And this happened in the summer! That’s when I decided it might be in my best interest to go back to grad school under Dr. Menge and work on the cause of a citrus trunk disease.

I have worked on a lot of projects over the years with the professors, specialists and other farm advisors. Just a few highlights from over the years:

Dr. Mary Lu Arpaia and I started an avocado rootstock trial in 1986 that evaluated the yield of some of our new rootstocks in “clean” soil (without *Phytophthora cinnamomi* root rot). It turned out to be a very important trial because it showed that the G755 series (our most resistant rootstock to root rot) was actually very poor at producing fruit when it was grafted to Hass. From there Dr. Arpaia and I and the other farm advisors all worked on irrigation trials and fertilizer trials in order to establish some basic information on the water and NPK requirements for Hass avocados.

I conducted a reclaimed water trial with the City of Escondido from 1991 to 1996 and the results showed that, because of the high salt content in their reclaimed water, yields were reduced by 40% compared to district water. But that set the stage for a current trial by Dr. David Crowley with the City of Escondido in which reverse osmosis will be used to separate the brine out and have it go out to the ocean in their outfall. The less saline reclaimed water will then be piped to the backside of Escondido to be used for agriculture. I think, with our high water prices that may be the future in our county.

Ben Faber and I conducted avocado pruning trials in the late 90’s and early 2000’s, which showed mixed results, but taught us some lessons. Pruning should be done early in the year, and not in the summer because that’s when fruiting wood is forming for the following spring. These results will be described again in a future article.

At the same time, Ramiro Lobo and I started blueberry variety trials and eventually irrigation trials. This work, along with work by advisors Faber and Mark Gaskell, set the stage for a new crop in California: low chill early season blueberries. Unfortunately, this is definitely not a low water-using crop. In fact, in a Valley Center trial, we got our best yields when we irrigated with 40% more water than avocados (on an acre basis).

For the last five years I have worked on IPM techniques to control the *Diaprepes* citrus root weevil along coastal San Diego and Orange counties (in conjunction with Jim Bethke, Joe Morse and Loretta Bates). We used a special landscape cloth under the lemon trees to block the adults from emerging from the soil and it also blocked the young weevils that had just hatched on the leaves from entering the soil. Blocking the entrance and exit turned out to be a great IPM technique for controlling this pest. We also imported parasites from Florida and released them, and the parasites established. These releases have apparently slowed down the spread of this invasive pest because we do not see that they are spreading away from the original quarantine zone. Without the parasites, I doubt that our citrus along the coast would be surviving today, based on all of the sick and dying lemon trees we saw at the beginning of this project.

Currently I have a project with the California Avocado Commission which is taking a look at two pruning styles for a high density planting of Hass and Lamb Hass. Connected to this project are classes for new avocado growers. I will continue this project at least for the next three years as an emeritus farm advisor. Why? Because I think high density has the potential to increase yield per acre substantially, and it's just so darn interesting!

Now, I'm going to do some fishing, and a little house painting.

'Meyer' Lemon and C-35 Citrange Rootstock

Ben Faber

Citrus is a messy botany. It loves to cross with anything and in so doing creates very complex ancestry. C-35 rootstock is a citrange and was created for its tolerance to cold, but is also good in Phytophthora situations and creates a slightly smaller tree. Oddly, it is deciduous, a cross between Poncirus and Citrus. It's a trifoliate hybrid. 'Meyer' lemon is the same mess, a cross between a lemon and an orange/mandarin. You would think these two messed up cousins might do well, but in several instances there is an incompatibility. 'Meyer' has been grown successfully on 'Macrophylla' and 'Yuma Ponderosa', both of which are also complex hybrids.



Hot, Dry Weather and Avocado Pollen Viability

Ben Faber

With hot, dry winds, the question came up this week about whether the hot temperatures or the low humidity would affect pollen viability. It turns out that both day and night time temperatures will affect pollen tube

growth. That in 'Hass' approximately 48 hours about 50 deg F is needed to complete pollen tube growth and fertilization. If temperatures drop at night to below 50, there's not enough time for fertilization to occur. As temperatures increase, fertilization occurs more easily. In the tropics, there can be high temperatures and high humidities and good fruit set. But this question was not about fertilization, but how long the pollen would remain viable at high temperatures and low humidities. Work was done Loupassaki and Vasilakis for the World Avocado Congress III Proceedings and they basically found that when humidity dropped below 40%, viability was very low. This last week we have seen humidities below 10%. It probably means that even with bee visitation, non-viable pollen is being delivered to the flowers. When humidities come back up, there will probably be good fertilization, as long as we have decent day and night time temperatures. Many years ago Gary Bender, down in San Diego, went to the Gulf Region of the Middle East to help establish an avocado orchard. The trees flowered, but never set fruit

Are Hops a Serious Option as a Crop in San Diego?

Gary Bender

Farmers in our county who are using high-priced water are really thinking about "niches" in the market. They simply must get the best prices they can if they are going to stay in business.

So, what are these "niches"? One niche is simply converting to an organic operation. This can usually mean higher prices, but the increase in cultural costs must be carefully considered (spraying glyphosate for weed control is a lot cheaper than hoeing, but glyphosate is not organic!). It can be an early variety that hits the market ahead of other areas (early season, low-chill blueberries), or it can be a crop that is later than other farming districts (Gold Nugget mandarins), or it can be a crop that is desired by a local market (tropical guavas for the Hispanic population).

We might have a niche local market for **hops** developing right before our eyes. According to Wikipedia, San Diego has 87 craft breweries and brewpubs, with 31 more on the drawing boards. I have heard that our local craft beer makers might like to buy local hops.

But, can they be grown here? Over the last 30 years I have tried to steer growers away from growing crops that have a high chilling requirement. I've talked would-be pistachio and cherry growers from planting because they both have winter chilling requirements in excess of 900-1000 hrs below 45 F. In the case of hops, they have a chilling requirement and we think a long daylight requirement, which they get in the Northern climates. And I've told a lot of people that hops don't do well south of San Francisco (because that's what I read on the internet). But some people planted hops anyway, and guess what! They do grow here!

But they don't always bear fruit (cones). Local growers have told me that 'Willamette', 'Centennial' and 'Northern Brewer' do not produce well. But 'Cascade' and 'Nugget' have been producing from young vines at the Star B Ranch in Ramona. And other growers have been able to produce with 'Chinook', 'Galena', 'Perle' and 'Tomahawk'. Now, will they produce the quantities needed to compete in a commercial market, pay the water bills and make a profit? This sounds like a farm advisor trial in the making!

You may wish to read a good article on growing hops that was prepared by Gordon W. Morehead and Paul Vossen with UCCE in Sonoma County <http://cesonoma.ucanr.edu/files/27166.pdf>.

Growing Hops. Hops are usually started from rhizomes (root cuttings) planted in hills about five feet apart in the early spring. Hops grow quickly as vines on a tall trellis. Most growers erect poles about 16-20' tall, run wires between them and drop stings down about five feet apart for the vines to climb. Three trainings are done every fifteen days to get the vines to grow up the stings properly.

For irrigation a local grower in San Diego has reported to me that (in her second year) she used drip irrigation with a 1 gal/hr dripper/plant for 20 hrs in a set, two sets per week. She fertilized 3 times per season with 1 lb 5-1-1 organic fertilizer and liquid fish emulsion (not sure how much) through the irrigation system. She just completed her second year so I'm not sure what her water and fertilizer requirements will be in the third year when the vines are in full production.

Harvesting is done in August-September by cutting down the vines and either taking them to a machine that separated the cones from the leaves and vines, or by hand. In her case she bought a harvester for \$14,000 that "is a necessity if you have a lot of vines". Depending on the requirement of the buyer, the grower may have to dry the cones and chop them. The grower should work out the marketing requirements well in advance of the harvest.

Are hops going to make it as a new crop in San Diego? We don't know, but stay tuned!



Working the hops trellises in the 'olden' days



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