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Autumn Greetings!
My first season here has been a great learning opportunity. I have monitored several key insect pests, conducted the first year of chemical thinning research in stone fruits, and encountered many interesting pest problems during local "farm calls". I am thankful for the support and cooperation of the many growers who have given me access to their farms and who have tolerated my questions about their operations. As winter approaches, I am beginning to plan for the annual growers meeting, where I plan to present the results of my research and bring in other University researchers as well. Watch for the meeting notice this winter!

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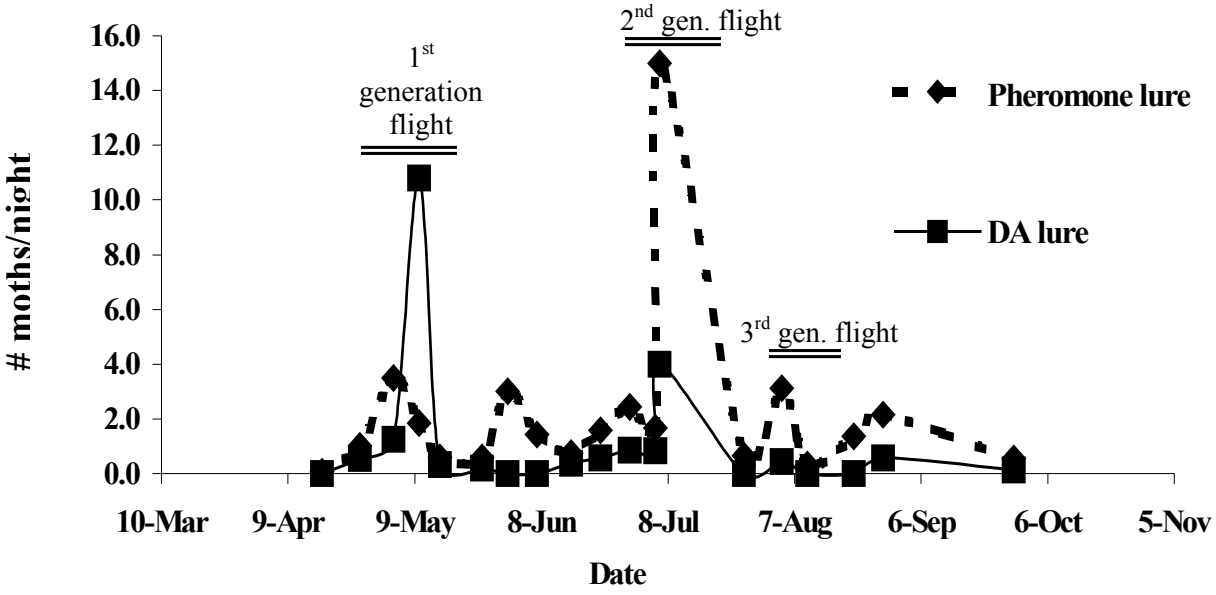
Codling moth trap catches comparing two lures and in orchards under different management regimes in 2001.

Codling moth (*Cydia pomonella*) continues to be a difficult pest for apple and pear growers, due, in part, to the short window of time that chemical treatments can be applied for effective control. Daily temperature information combined with in-orchard pheromone trap catches is necessary to accurately time treatments. If mating disruption is used, pheromone traps can provide the grower with some indication of how well the disruption is working, although this can be misleading as pheromone trap catches do not always reflect fruit damage.

This past summer I familiarized myself with local codling moth population trends by monitoring in three apple orchards with different management regimes: conventional chemical cover sprays, mating disruption using Puffer dispensers, and organic management with mating disruption using twist-tie dispensers. All of the orchards were located near Camino. In each orchard 2-6 wing traps with Trece L2 pheromone gray septa lures (approx. 1 mg. lures) were placed in trees and monitored weekly as time permitted. Lures were changed after approx. 8 weeks and traps were changed as needed.

In addition to the pheromone lures, which attract only male moths, traps using a new lure (labeled "DA") were also monitored. The "DA" lure is being developed by USDA researcher Dr. Doug Light in cooperation with Trece, Inc., of Salinas. Dr. Light provided all of the lures and traps for this project. The DA lure is made from plant chemicals derived from pear fruit and attracts both female and male codling moths. Much of the work done on the DA lure thus far has been conducted in walnut orchards, where the pear-derived lure appears to be preferred by moths over the nuts. We are interested in learning if and how this lure can be used in apple orchards. Since the lure does attract female moths, it has potential to be used in orchards under mating disruption as a means to measure population trends. For example, in an orchard under mating disruption, no moths should be found in traps with pheromone lures since, if the disruption is working, the moths should be too confused to locate the traps. A trap with the DA lure, however, should still attract moths, even in a disrupted orchard, and could provide information about the codling moth's population levels. In an orchard using conventional sprays, the lure may help to more accurately time treatments based on female moth (and therefore egg hatch) activity.

Figure 1. Codling moth trap data collected from a conventionally managed apple orchard in 2001 (mixed varieties). The dashed line indicates pheromone lure trap catches, the solid line indicates "DA" lure trap catches. The y-axis indicates number of moths trapped/night.



April 25: Biofix. Degree day (DD) accumulation begins.

May 11-14: 250-300 DD. Grower applies treatment May 16.

June 21: 2nd biofix, start of next flight (1060 DD from first biofix).

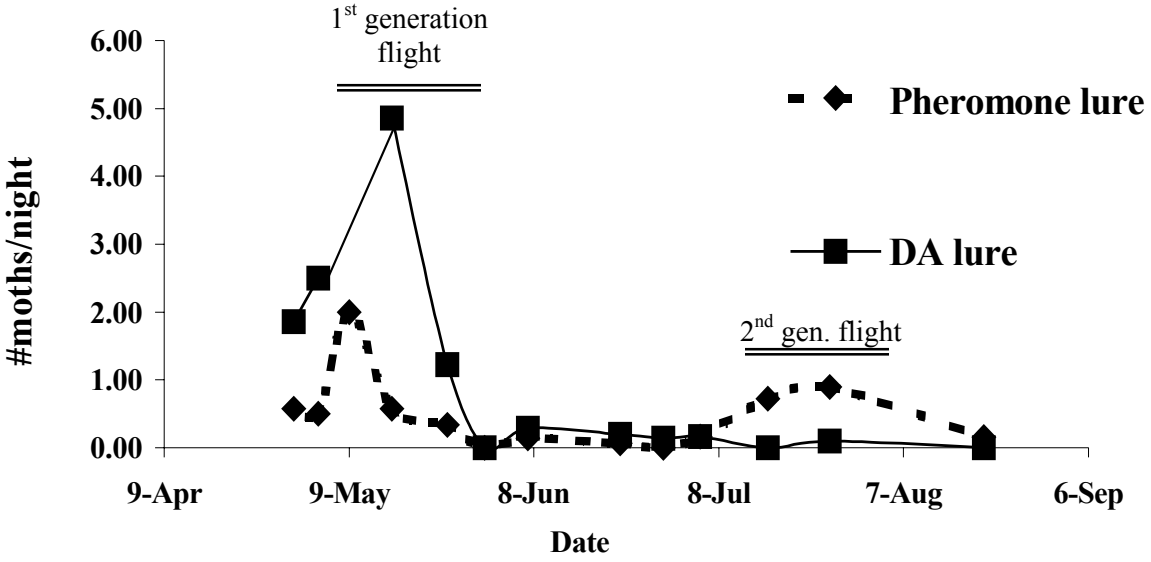
July 3: 250 DD. Grower applies 2nd treatment July 7.

Aug. 11: 3rd biofix, start of 3rd flight. Grower applies 3rd treatment on Aug. 12. 250 DD accumulated on Aug. 22.

Figure 1 shows the trap data collected from the orchard under conventional management. Please note that the trap catches are presented as number of moths per night. This allows for accurate comparison of the data. The first flight had a very strong peak indicated by the DA lure on May 10, a week later than the pheromone lure's peak. Some researchers believe this is an indication that the male moths emerge from overwintering before the female moths, although this is not really known. A 1b peak was indicated by the pheromone trap on May 31, but not detected by the DA. This could mean there was not a strong female 1b flight and therefore there would be no need to treat at that time (this grower did not treat the 1b.) On July 6th the second-generation flight peaked, this time the pheromone lure caught more moths than did the DA lure, although both lures detected a peak on the same date. The third flight was small and was not detected by the DA lure. Was this because the female moth activity was low at this point, the lure was weak, or was the lure less attractive to moths as the apple fruit on the tree matured? At this point, I don't think we know the answer to that question. The grower treated three times with either Imidan or Guthion, timing his treatments with our trap data, and estimated his final fruit damage at harvest to be less than 1%.

Figure 2 below shows the data collected from the second orchard which used pheromone mating disruption with the pheromone delivered using the Paramount (now the company called SuTerra) Puffer technology. As with the first orchard, the first generation trap catch was higher with the DA lure than with the pheromone lure and peaked a week later, on May 16.

Figure 2. Codling moth trap data collected from a orchard using Puffer mating disruption in 2001 (Gala variety). The dashed line indicates pheromone lure trap catches, the solid line indicates "DA" lure trap catches. The y axis indicates the number of moths trapped/night.



April 25: Biofix. Degree day (DD) accumulation begins.

April 30: Puffers up in orchard.

Since the puffers were up in the orchard beginning April 30 distributing pheromone, we would not expect to see codling moth trap catches in the pheromone traps after that. This was generally the case. However, in this orchard, the DA lures also did not detect much moth activity after the first flight. Only a slight increase on June 7th (corresponding to the 1b flight) was noteworthy. For some reason, the DA lures did not give us the second flight information in this orchard that we saw in the conventional orchard. One potential reason could be that fruit odor from neighboring pear trees may have competed with the DA lures. However, due to the late frost, there was not a heavy set on the pears and most of the fruit was rat-tail blooms.

The grower made one Guthion application along the top 4 border rows in this orchard on June 15 and another application in early August. At harvest, I inspected 1000 fruit near the Northeastern edge which bordered some unsprayed apples and pears and found a large amount of codling moth damage, 18%. I also inspected 1000 fruit towards the middle of the orchard and found 9% fruit damage there. A strong first flight from the overwintering generation and mated codling moths entering this block from the adjacent unsprayed trees were probably responsible for most of the damage in this orchard. I would suggest to anyone considering trying to use the Puffer pheromone technology to make sure that they plan on treating for the first generation with conventional materials such as Guthion. This should help knock down successive generations.

In addition to the pear plant chemicals used as a lure, Trece also plans to include these attractants in a lure containing insecticides as an "attract and kill" product. This type of product could be extremely useful in orchards too small for successful mating disruption programs.

Rainfall accumulation (inches) at the CIMIS station in Camino: a historical perspective.

	2001	2000	1999	1996	1991	1986
January	4.8	13.73	8.43	10.74	0.63	5.13
February	5.29	15.95	13.3	9.69	4.21	4.53
March	2.79	2.09	3.44	6.15	13.94	6.07
April	4.61	2.68	2.84	4.87		1.42
May	0	4.92	1.46	5.88	2.25	0.24
June	0.16	0.79	0.43	0.2	2.88	0.68
July	0	0	0	0.12	0.04	0.48
August	0	0	0.12	0.24	0.16	0.08
September	0.79	2.13	0	0.2	0.04	3.3
October		7.53	1.65	2.24	4.33	0.01
November		1.9	5.27	8.36	1.78	0.98
December		2.01	0.68	21.66	2.87	1.05
YEAR	*18.44	53.73	37.62	70.35	34.7	23.97

*9 months

Cork Spot in Peach and Nectarine.

A problem determined to be "Cork Spot" appeared locally in the cling peach variety "Orange" this season that I found to be very interesting. The condition appears at harvest as dark sunken spots on the surface of the fruit. Internally, the flesh turns brown, dry and corky. Tulare County Farm Advisor Kevin Day helped to diagnose the problem here and provided me with some information he researched after he saw severe losses due the problem in his county in 1998. Below is a synopsis of the information Kevin provided to me.

The Cork Spot problem has been identified in both yellow and white-fleshed fruit from a range of soil types and tree ages. Mostly mid-season and some late-season varieties have been affected. The fruit sides and blossom end are most greatly affected, symptoms are rarely observed on the shoulders.

The biggest question is "What is the cause of the problem?" The safest answer is that we do not know. Many answers have been given, the most frequent (although probably incorrect) being calcium deficiency.

What can be learned from calcium deficiency in apples? In apples, calcium deficiency is most severe in cool seasons and on lightly cropped vigorous trees. There are two major calcium related disorders affecting apples, bitter pit and cork spot. The visual symptoms are similar: dark spots on the fruit surface and dry corky breakdown of the flesh of the fruit. Bitter pit is a storage-related condition that only appears after fruit have been harvested and stored. Cork spot affects fruit on the tree and is made worse under conditions of low calcium, but is not caused by low calcium. Corking is also worse under conditions of high vigor and moisture stress.

Calcium nutrition has been widely studied and in apple production has a beneficial effect on fruit quality. But results of calcium sprays in stone fruit have been inconclusive. Most research in stone fruit indicates it is very difficult to get calcium into the fruit. Evidence exists that summer pruning may help improve calcium concentration in fruit by removal of competitive shoots. While helpful as part of an overall program, summer pruning by itself is not adequate to control severe calcium related problems.

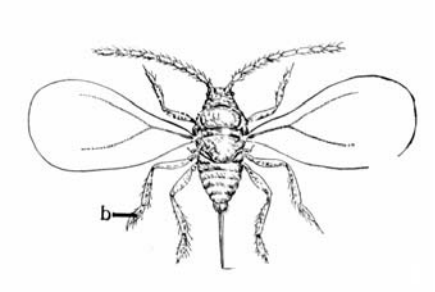
Boron. Boron deficiency is a potential problem in stone fruit production. Boron deficiency can affect flowering and fruit set but also can cause internal and external corking of the fruit. In apples it is known that if boron deficiency does not become severe until late in the fruit developmental period, the main symptom may be internal cork formation. This corking is worsened under conditions of heat and/or water stress. In peach, boron deficiency causes fruit to develop brown, corky areas in the flesh. Additionally, boron is readily leached by heavy rain and deficiencies are common under conditions of poor root activity, such as cold, wet springs.

Cork Spot-our best guess as to the cause. Although we do not know the exact cause of Cork Spot disorder, Kevin believes that environmental stress plays as much a role as either boron or calcium deficiency. Cool spring weather, followed by exceedingly hot temperatures and water demand, may cause some imbalance in developing fruits. Vigorously growing trees that have been pushed with excessive nitrogen can be even more susceptible. Boron applications in fall or spring, such as Solubor at the top of the labeled rate, may be helpful in reducing Cork Spot at harvest.

Managing San Jose Scale with horticultural oils.

Dormant season is fast approaching and it is an excellent time to apply horticultural oils for control of San Jose Scale (*Quadraspiotus perniciosus*) infestations. San Jose Scale (SJS) attacks a wide range of woody plants, and can be a serious pest in all stone fruits, apples, and pears. Scale is a sucking insect that injects a toxin as it feeds and severe infestations can kill fruit wood, cause deformed, bumpy fruit, reduce yields and eventually kill a tree.

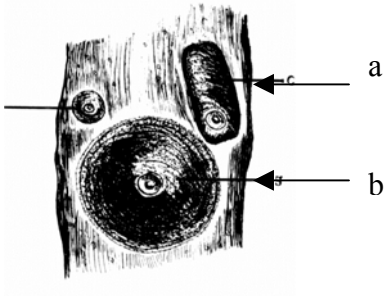
Scale life cycle. SJS emerges as bright yellow crawlers, about the size of mites, from female scale; there is no visible egg stage. The crawler stage is the only one in which an infestation can spread, often by wind. All other stages, except adult males, are immobile and attached to the feeding site under the scale covering. Within 24 hours of birth the crawler settles on the bark, loses it's legs, puts it's mouthparts down to feed and begins to lay down a circular, white waxy covering. After about a week, a band of dark wax appears around the edge of the white cap, marking the beginning of the black cap stage. About 80% of SJS overwinters as the black cap stage on infested twigs and branches. In spring, when the weather warms, black cap nymphs grow and molt. Male scales become oblong in shape, females remain circular. Males molt 4 times before maturity and after the last molt emerge from under the scale as a delicate, winged brown insect. Females live under the scale covering with a bright yellow body and no appendages. The females produce a sex pheromone to attract the winged males, which mate immediately after emerging. After 5-6 weeks, the female produces crawlers and the cycle begins again. Depending on the temperatures, 3-5 generations of scale occur.



Left: male San Jose Scale in winged mature stage.

Right: a: immature male in cap stage, b: mature female.

Drawings from: "How to know the insects", 3rd edition. R. Balnad and H.E.Jaques.



Fall monitoring. Fall is a good time to examine wood for crawler settling. The crawlers will form the black cap which is about half the size of a pinhead, and this will be the overwintering stage. It is also the stage which can best be controlled by dormant oil applications. Examine this year's wood growth that arises from relatively large scaffolds at about head height to detect SJS. Often circular red rings can be found which indicate feeding. If they can be found easily (a scale per spur is a high population) treatment during the dormant season is recommended. Another indication of problems are dead interior branches with dried leaves remaining attached, even after healthy leaves fall.

Dormant oil research. Research done by Edward Anthon of the Tree Fruit Experiment Station in Wenatchee, Washington in 1957 demonstrated the effectiveness of oil used alone, without added organophosphates. In that very early work, Anthon tested Volck Supreme Oil used alone at 2 gal. or 1 gal. in 100 gal. of water compared to a combination of Oil + organophosphates, including Diazinon, among other then-registered materials. Anthon found that the Oil alone at the 2 gal. rate killed 98% of the scale, compared to Oil + Diazinon which killed 96.5% of the scale.

Today, research on the best use of horticultural oils for SJS control continues. Studies conducted in 1999 and 2000 by Kearney Ag. Center researchers Walt Bentley, Lee Martin, Dick Rice and Brian Ribiero and UCCE Tulare County Farm Advisor Kevin Day evaluated the efficacy of narrow range horticultural oils applied during the delayed dormant period to plums for control of Scale. In 1999, either Volck Supreme or Orchex 692 oil applied at the green tip stage of growth of plums at the rate of 8 gallons of oil in 400 gallons of water per acre gave significantly better control of SJS than no treatment. SJS infestation of Black Amber was less than 1.5% with either oil while the untreated check infestation was 10.75%. SJS infestation of the Queen Rosa cultivar was less than 5% while the untreated check infestation was 14%.

Volume and speed important for good coverage. In 2000, the researchers compared the difference of dilute and concentrate dormant oil spray applications. 8 gallons of Exxon 100 Dormant Spray Oil was applied using an Air-O-Fan Sprayer in either 100 gpa or 400 gpa of water, both at a speed of less than 2 mph. For both Rosemary and Royal Diamond cultivars, the 400 gal. application resulted in significantly fewer infested fruit.

Program benefits. Horticultural mineral oils can be effectively used to manage SJS. The use of oil alone reduces the cost of the pesticide to growers. Recently, resistance to organophosphate pesticides in SJS populations has been documented in California. Horticultural oils can be used to combat insecticide resistance since oils act by smothering and have no biochemical effect. In addition to the problem of resistance, organophosphates have been detected in the Sacramento River drainage system. Using oil alone means fewer regulations that farmers must deal with. If you plan to use dormant oil applications remember that dilute applications will be consistently better than concentrate. Peaches and nectarines should be treated in December-January while plums should be treated later, at green tip.