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ORCHARD FACTS

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Sacramento Valley Almond Newsletter

Observations on Krymsk 86 Rootstock

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Krymsk 86 is a peach-plum hybrid rootstock (*Prunus persica x P. cerasifera*) that originated in the Krasnodar region of Russia. As such, this hybrid rootstock is different than any other rootstock in use in the California almond industry. Now that it is planted in commercial orchards under many different conditions we are learning more about how it behaves when grafted to almond.

When grafted to peach, plum, or apricot it is thought to be tolerant of cold temperatures, drought, water logging, resistant to phytophthora, and somewhat resistant to lesion nematodes. It was observed to be precocious, productive, and appeared to increase fruit size. Now that it is grafted to almond in California we are discovering that trees behave differently than almond grafted on peach rootstocks and differently than almond grafted on Marianna 2624 plum. In fact, almond grafted on Krymsk 86 is unique.

The first trial in Butte County including this rootstock was planted in 2003. Just completing their ninth growing season, the Nonpareil trees on Krymsk 86 are larger than adjacent trees on Lovell peach. What we know so far is that Krymsk 86 appears to be compatible with almond and it has a vigorous root system with good anchorage as a young tree. Krymsk 86 roots are susceptible to root knot nematodes and this will limit its usefulness in the San Joaquin Valley and on light textured soils where root knot can be a problem. In sandy soils in Stanislaus County, trees on Krymsk 86 are less vigorous than trees on peach roots.

In spring 2011, soils were wet and cold for an extended period causing trees to get a slow start. Several young orchards had yellow trees showing up on Krymsk 86. Trees were yellow for several reasons, none of which appeared fatal. In one young orchard planted on heavy clay adobe soil, trees yellowed at the wettest end of the field showing normal sized leaves that were just pale. They had not received nitrogen fertilizer and I believe the wet, saturated conditions denitrified available nitrogen present resulting in a transient nitrogen deficiency. As soil dried out and warmed up, they improved.

In another orchard, the yellowing was displayed as interveinal chlorosis symptomatic of manganese deficiency. Yet another young orchard displayed both zinc and manganese symptoms in the leaves where the trees on Krymsk 86 were yellowing. An older orchard on peach rootstock was also displaying manganese deficiency in an adjacent area. These micronutrient deficiencies usually occur in soil related areas in orchards and are more prevalent when soils are wet, cold, and saturated, reducing root activity and nutrient uptake. Krymsk 86 appeared to be sensitive to these conditions. In the past, I have observed trees on Marianna 2624 plum rootstock displaying fewer manganese deficiency symptoms than adjacent trees on peach roots.

Finally, some young yellow trees on Krymsk 86 displayed symptoms similar to the union mild etch (UME) problem that occurs on Marianna 2624 plum rootstock when soils are too wet during the growing season. On Marianna 2624 this problem is more prevalent on varieties in an orchard that are the least compatible with the rootstock such as Butte and Monterey. On Marianna 2624, once growth is affected by UME, leaves turn pale yellow and growth may stop. When severely affected, leaves roll and scorch on the margins, and trees may defoliate. Some trees die or remain weak enough to be removed although most affected trees recover the following year. Some possibly less compatible varieties on Krymsk 86 displayed similar symptoms with pale yellow trees or trees with rolled leaves where growth stopped in the late spring as they coped with saturated soils. Once soils warmed and the irrigation season progressed some trees began to improve and put out a new flush of growth.

So, sometimes Krymsk 86 behaves somewhat like it's plum half while other times it behaves like it's peach parent. Whether it can tolerate extensive winter waterlogging like Marianna 2624, resist wood rots and blow-overs as the trees age, or tolerate oak root fungus better than peach roots will be discovered as these young orchards age.

A Short Review of Three Micronutrients: Zinc, Manganese, and Iron

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When thinking about a fertilizer plan for almonds, the key macronutrients nitrogen and potassium are the major concerns, but you should be on the lookout for symptoms of deficiencies in micronutrients as well. Micronutrients are needed by the tree in much smaller amounts than macronutrients, but deficiencies can be detrimental to tree health and yield. The first step is understanding the nutrient status of your orchard by doing leaf tissue analysis in July to determine if any nutrients are borderline or deficient. Micronutrient deficiencies often show symptoms in only a small part of an orchard or, if due to weather, may only be seen during part of a season. This article will discuss zinc, manganese, and iron deficiency symptoms and correction, and their importance to plant growth.

Photo 1. Zinc deficiency 'little leaf' syndrome (UC IPM photo)

Zinc (Zn) is the most likely of these three to show deficiencies in Sacramento Valley orchards. Zinc is part of the enzyme system that regulates terminal growth and plant cell expansion. It also plays a role in pollen development and flower bud differentiation. Fruit set can be decreased if zinc is deficient and severe deficiency can result in dormant flower bud drop. The first symptoms of deficiency show up in the spring with trees blooming and leafing later than normal. The terminal growth with severe deficiency will have shortened internodes and small leaves; often the leaves are chlorotic and will have curled or wavy margins (photo 1). The small leaf symptoms are known as ‘little leaf’. If the deficiency is not severe, leaves may be only slightly smaller than normal showing areas of interveinal chlorosis. Young trees can be deficient without showing any visual symptoms, so it is important to get a July tissue analysis even in young orchards. Zinc is deficient if a July leaf analysis is below 15 ppm. Zinc deficiency can be easily corrected with a fall foliar spray of zinc sulfate (10 to 15 lbs. $ZnSO_4$ in 50-100 gal. water/ acre) or it can be applied through micro-irrigation during the growing season in a chelated form (example: ZnEDTA). Soil uptake of zinc is decreased if the soil pH is too high (>7.5). Foliar sprays are generally less expensive and are effective. A late fall foliar spray will promote early defoliation of leaves helping to decrease blow overs if seasonal storms come early.

Iron (Fe) and Manganese (Mn). Deficiencies in iron and manganese are rare in the Sacramento Valley, but can be seen occasionally in orchards with high soil pH above 7.5, in calcareous soils, or in heavy, poorly drained soils. Both iron and manganese are important in chlorophyll formation so a deficiency in either will show an interveinal chlorosis in young leaves. Iron chlorosis will often leave the small veins green with interveinal yellowing, or if more severe, will be uniformly yellow throughout the leaf. Iron deficiency may show early in the season and continue until leaves yellow and drop or it may show in the spring and then gradually disappear as soils warm up and dry out. Leaf analysis is not a reliable indicator of iron deficiency. The best approach is to recognize leaf symptoms. Manganese interveinal chlorosis will be blotchy or mottled producing a herring bone pattern with major veins green between yellow interveinal areas. Manganese is adequate when July leaf analysis is over 20 ppm. Manganese deficiency can be corrected with foliar sprays of manganese sulfate at 2 pounds per 100 gallons water. If you have a small problem area, banded soil applications of manganese sulfate at 10 pounds per tree have been effective for longer term correction.

If deficiencies are found in almonds, the first steps should be to get the water and soil tested to see if the pH is too high. If that is the case, a remedy may be to band elemental sulfur or chisel sulfuric acid about 3-4 feet from the tree row creating an area of lower pH where the trees can pick up these nutrients. Another approach would be to lower the pH of the irrigation water by injecting sulfuric acid which in turn will lower the pH of the soil improving iron, manganese, and zinc uptake. Cold soil temperatures and water logged soil conditions can create a temporary situation which reduces uptake of all three of these micronutrients.

Review of Navel Orangeworm Control Research in Almond

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Navel orange worm (NOW) is the major pest of almond production in California. Damage to nuts from this pest can cost growers from a few to hundreds of dollars per acre depending on percent damage and total yield. NOW damage also increases the market risk for the entire California almond industry. Aflatoxin levels in kernels increase with NOW damage. The European Union (EU) – a third of the entire market for California almonds -- is very aware of alfatoxin risk and has put the California almond industry on notice that efforts must be made to insure that alfatoxin contamination of almonds remains below their standards. At the same time, the EU wants almond production to be more sustainable, so there is also market pressure to move away from broad spectrum pesticides like pyrethroids (Asana, Warrior, Brigade, etc.) to softer practices such as mating disruption and lower environmental risk pesticides (Intrepid, Altacor, Delegate, Belt, etc.).

A large study on new approaches to NOW control is entering its fifth and final year in California. This is a USDA project, funded by the federal government, with additional support from the almond and pistachio industries. USDA, UC and private researchers and PCAs are doing the work. This article is a brief review of NOW management research and practices in almonds presented at an overall project meeting held in Parlier, CA this September.

Overall NOW control plan: The NOW population in an orchard can build rapidly from spring to fall without grower action. There are 2-3 full generations of NOW in an orchard depending on the year and location. Female NOW can lay almost 100 eggs in a lifetime. NOW are strong fliers and can move from one orchard to another. Total NOW control in an orchard is difficult. Key to effective NOW management is reducing the population as much as possible at as many times as economically possible in a season through cultural and if necessary chemical means.

NOW overwinters in mummy nuts in the orchard, and mummy fruits and nuts on trees in the surrounding area. Adult moths emerge in the spring and lay eggs on mummy nuts. NOW feeds on mummies until hull split in summer when split new crop nuts – a better food source – attract egg laying females. The NOW population increases rapidly with this new food source. The Nonpareil hull split spray protects those valuable nuts, but it also decreases the entire NOW population, reducing the risk of damage to the late harvested pollenizers like Monterey. With soft pesticides (low risk for flaring mites and a short PHI) now commercially available, some San Joaquin Valley growers with high NOW pressure have moved to a three spray program (May, hull split and post hull split) to try to suppress the NOW population enough to reduce overall damage. Due to good sanitation practices and higher rainfall that increases mortality, Sacramento Valley growers may not need to treat or generally don't need more than a May or hullsplit spray depending on year and proximity to other sources of potential NOW infestation such as nearby unmanaged orchards.

Orchard Sanitation: This key practice remains the foundation of any NOW management program. In the northern San Joaquin Valley and Sacramento Valley, the established target level of mummy nuts in the canopy as of February 1 is 2 mummies/tree. In orchards where more than that level is found, knock mummies from the trees using harvesters or poling by hand. All mummies on the orchard floor should be destroyed (mowing, discing, etc.) by March 15. A new target of less than one mummy in two trees (average of 0.5 mummies per tree canopy) and 4 mummies/tree on the ground has been suggested for Kern County orchards. View the research article on this topic at: http://ucanr.org/u.cfm?ids=2281. In many years and in many locations – especially in the Sacramento Valley – Mother Nature (birds, rodents, and winter storms) virtually eliminate mummy nuts in almond orchards by the end of winter and no sanitation efforts. However, it is always good to monitor mummies every winter to make sure that NOW population starts the season as low as possible. Natural mummy fall may not be as great during dry winters, and orchard sanitation may be needed under those conditions.

Mating Disruption (MD): Work in large (1000s of acres) blocks in the San Joaquin Valley shows that the combination of 2 NOW pheromone puffers/acre and "soft" pesticides can keep NOW pressure and damage at very low levels. These orchards were high pressure sites before the study and were "cleaned up" with a rigorous pesticide program, including pyrethroids, before the MD study was begun.

Mating disruption can work, but needs careful monitoring and large scale cooperation between neighbors to work well across an entire area. Upwind portions of a MD block can have high NOW damage at harvest if neighboring blocks have high pressure. Mating disruption is not a standalone practice under high NOW pressure.

Insecticide Efficacy: New pesticide chemistries -- Intrepid, Altacor, Delegate, Belt, etc. -- can kill NOW eggs or larvae as effectively as pyrethroids. Coverage is the big challenge with these new materials. Research continues to improve NOW control from newer pesticide chemistries to 1) manage pesticide resistance, 2) avoid late season spider mite outbreaks, and 3) work to meet market demands for more sustainable pest management. Finally, pyrethroids are extremely toxic to fish at levels as low as 1 part per billion. Alternatives to pyrethroids may be needed if regulation limits the use of this popular pesticide chemistry.

Spray Coverage: Regardless of the pesticide in the spray tank**, s**pray coverage makes a huge difference in NOW control. Field tests showed that in the tree canopy above 10 feet in height **s**pray coverage and NOW control generally decreased. Poor spray coverage and lower NOW control occurred in the upper quarter of almond tree canopies compared with the lower canopy. Slow tractor speed (2 mph) and higher spray volume (200 gallons/acre) provided the best NOW control in studies in the San Joaquin Valley. Work to improve pesticide spray coverage is continuing in the Sacramento and San Joaquin Valleys.

NOW monitoring: Ten to fifteen NOW egg traps per orchard are needed to accurately detect NOW infestation when the population is low -- as often is the case in the crucial spring period. Strategic placement (distributed nearly equally on edges and interiors plus known hotspots) of these traps has been demonstrated to be the most effective approach and has provided information that contributed to successful management of both mating disruption and conventional insecticide based programs. Differences in trap bait materials are far less important than number of traps in effective pest monitoring.

NOW pheromone trap: An effective pheromone trap has not, yet, been developed. The NOW pheromone mix is very chemically fragile and degrades within days when placed in the field. Work continues, and some progress is being made. There is hope of a commercially available lure in the next 2-3 yrs. When available, this lure will be a great addition to assist in monitoring and managing NOW populations. For now, growers and PCAs must use multiple egg traps to track NOW populations.

This large, federally funded NOW research project will continue for another year. Further updates on the research in this overall project are available at the Almond Board of California's annual conference in Modesto on December 7-8.

Gopher Control

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Pocket gophers are burrowing rodents that cause problems in many crops in California. Gophers spend their lives underground in tunnel systems where they can feed on tree roots, although sometimes they feed on vegetation at the edge of an open burrow. Most feeding takes place at a depth between 8 and 16 inches, although their burrows can be as deep as 3 to 4 feet. Gophers live alone within their burrow system except during breeding season, producing offspring in the spring and fall. They push up soil and come to the surface to cross barriers or move to a new area.

Spring is the best time to control gophers since gopher activity heightens as the soil warms up and their population can be reduced before they start reproducing. Horseshoe shaped mounds of soil with a side hole plugged with soil indicate gopher activity near the surface.

There are several control measures available to manage gopher populations; however, using an integrated approach with two methods – traps and bait -- is most reliable.

Locating the burrow: It is essential to accurately locate the gopher's main burrow with the help of a probe. A gopher probe can be constructed from a PVC pipe or metal rod, or it can be purchased commercially. An enlarged tip that is wider than the shaft of the probe is an important feature for locating burrows. First, locate a fresh mound of soil, which indicates recent gopher activity. It is important to find the main burrow as gophers may not revisit lateral tunnels; therefore, placing traps and baits in them would not be effective. The main burrow can be found by probing 8 to 12 inches from the plug side of the soil mound. When the probe enters the burrow, there is a 2-inch gap in resistance to probe movement.

Trapping: Several types of gopher traps are available; the most common type is a two-pronged, pincher trap (Macabee, Cinch, Gophinator), which the gopher triggers as it pushes against a flat, vertical pan. Another popular type is the choker-style box trap. Although they vary in design and method of placement, they are all effective.

These traps are set in main tunnels near fresh mound activity. Two traps are set 12 - 18 inches into the main runway in opposite directions to ensure interception from either side of the burrow. The traps are tied to a locating stake and the hole is covered to exclude all light.

It isn't necessary to bait traps, however, you may increase your chances of capture by placing lettuce, carrots, apples, alfalfa or peanut butter as bait.

Check the traps often and if capture doesn't take place in two days, replace traps. Since there is usually only one pocket gopher in each tunnel system, traps should be set at new locations after a gopher is trapped. Exceptions include breeding season or when a young gopher is caught, since other juveniles may be in the same burrow.

Baiting: Find the main burrow using a gopher probe as described above. The main types of effective poison baits are: strychnine saturated grain, and anticoagulants that are used for other rodents and vertebrate pests as well.

Strychnine is a very effective and fast acting chemical after a single feeding. Since its decomposition rate in moist soil is high, it offers reduced control for re-invaders moving into the same burrow system. Place the bait in the main burrow and close the hole with rocks or materials that block the light and prevent soil from falling into bait. Deposit a few chemical baits within the same tunnel system. This will increase the success rate. If you detect new soil mounds, reapply baits in two days.

Anticoagulants are also placed in the main burrow. The advantage to this chemical is that it is available for multiple feedings and can kill more than one gopher at a time as long as bait is available. The amount of bait used is significantly higher (10 times) than use of strychnine. These baits are less effective than strychnine, but they are also less toxic.

For use of chemical baits, always check the label and if you have questions, ask your local Agricultural Commissioner's Office.

Alternaria Leaf Spot and Leaf Rust of Almond

Bill Krueger, UC Farm Advisor, Glenn County, and Jim Adaskaveg, Professor, Department of Plant Pathology and Microbiology, University of California Riverside

Alternaria leaf spot and almond rust are fungal diseases of almond are prevalent this year and have necessitated additional fungicide treatments to minimize early defoliation. These two diseases are favored by high humidity and leaf wetness in the orchard. Recent extended wet springs and changes in cultural practices such as higher density plantings and microsprinkler irrigation with longer, more frequent irrigations are contributing to higher humidity, more accumulated leaf wetness hours from dew, and subsequently higher disease levels.

Figure 1. Alternaria Leaf Spot

Alternaria Leaf Spot is caused by a complex of Alternaria species including *A. alternata, A. arborescens* and *A. tenuissima.* Alternaria leaf spot appears as up to half inch diameter brown spots (Fig.1) on leaves. Leaf spots turn black as the fungus produces spores. Alternaria leaf spot develops most rapidly in the hot summer months, and can almost completely defoliate trees by mid-summer.

Disease management. Relying entirely on fungicides to control this disease can be costly and increases the risk of resistance development. Consider an integrated approach including:

- Planting less susceptible cultivars. Varieties most susceptible include Carmel, Sonora, Monterey, Winters, and Butte.
- Select a planting design which allows for air circulation. Orchards planted with rows in an east/west direction typically have more severe disease than orchards with rows in a north/south orientation.
- Prune and train trees to allow air circulation and reduce dew formation.
- Practice good foliar disease and mite control to minimize stressed and injured leaf tissue.
- Irrigate less frequently and with higher volumes to minimize relative humidity and subsequent leaf wetness.
- Practice orchard floor management to reduce relative humidity and the amount of senescing tissue colonized by Alternaria species.

Treatment programs should start with petal fall applications of Rovral or Bravo. The effectiveness of Rovral at this timing depends on the occurrence of environmental conditions favorable for the disease in early spring. Bravo is effective on both Alternaria and scab and is also useful later in the spring. To time treatments, use the Disease Severity Model (DSV) which is based on temperature and duration of leaf wetness.

Field resistance against QoIs (strobilurins – FRAC group 11) and SDHIs (FRAC group 7) has been observed in the Sacramento Valley so late-spring/early-summer applications (based on the DSV model) have to be done with other materials at most locations. New materials (Quash, Inspire Super - both containing FRAC group 3) and Ph-D (FRAC group 19) should be strictly used in rotations and mixtures for resistance management. Newer SDHI fungicides (different sub-groups) are proving to be highly effective, but the potential for resistance is also extremely high. Combination tank mixtures or pre-mixtures will be necessary for preventing resistance to the newer SDHI compounds. Fungicides effective for Alternaria leaf spot can be found at:
http://www.ipm.ucdavis.edu/PDF/PMG/fungicideefficacytiming.pdf.

Figure 2. Almond Leaf Rust

Rust is caused by the fungus *Tranzschelia discolor* and occurs sporadically throughout almond-growing areas in California. It appears as small yellow, angular spots on the upper surface of leaves and as rusty red pustules of spores on the lower surface (Fig. 2). The disease is favored by spring and early summer rains and is more likely to become serious in orchards near rivers or streams or other locations where humidity is relatively high in spring and summer. Excessive levels of nitrogen are also known to increase the tree's susceptibility. The disease causes leaves to fall prematurely and will weaken trees, reducing the following

year's bloom. The rust fungus survives from one season to the next in infected leaves that remain on the tree, as spores contaminating buds and tree bark, and possibly also in infected twigs. Rust is often observed in in young vigorous trees, especially second- and third-leaf nonbearing orchards where fungicides have not been applied.
In orchards with a history of rust, treatments should be applied before symptoms appear: 5 weeks after petal fall and followed 4 to 5 weeks later in late spring and summer with a treatment to control leaf infections. Two or three applications may be needed in orchards that have had severe rust problems. Fungicides effective for leaf rust management can be found in:
http://www.ipm.ucdavis.edu/PDF/PMG/fungicideefficacytiming.pdf**.**

When zinc sulfate (20-40 lb/acre) is applied in late October to early November hastening leaf fall, an increase in rust inoculum may be prevented. Otherwise, inoculum may build up, overwinter on the trees, and infect leaves the following spring.

Resistance management will be important in maintaining efficacy of currently available fungicides**.** Resistance development in *Alternaria* species to QoI fungicides was first detected in 2003/04. In 2005, field (practical) resistance was found in Kern County and in 2007 in northern California. In 2007, practical resistance to SDHI fungicides (group 7) was found in the northern and southern Central Valley. Thus, Pristine (QoI + SDHI) is not effective in some locations.

The following are some general suggestions for fungicide resistance management for leaf and bloom diseases:

- Rotate and mix fungicides.
- Use label rates, no every-other-row spraying (upper label rates for QoIs).
- Limit any single mode of action fungicide class to 1 or 2 per orchard per season.
- Start your fungicide program with a multi-site mode of action material (i.e., Captan, Bravo/Echo, Ziram, Rovral, sulfur). Note: sulfur can be used in combination with single-site mode of action fungicides such as QoI and DMI fungicides.

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