University of California Cooperative Extension Fresno County

Vine Lines

Stephen J. Vasquez, Viticulture Farm Advisor

June 2007 Issue

Refractometer Calibration, Use and Maintenance

Stephen Vasquez and Shannon Mueller

Harvest season will soon be upon us in the San Joaquin Valley, which means that testing fruit for maturity will become a daily task. Proper sampling for sugar is important for making decisions on harvesting specific varieties or locations. Often referred to as "soluble solids" or "sugar" testing, fruit maturity evaluation involves sample collection and testing procedures that accurately represent the crop. Testing for sugar content in fruit has become easier as technology has improved. However, improved technology cannot eliminate deficiencies in sample collection or errors caused by poor refractometer care and maintenance. Reviewing the following tips should improve the accuracy and utility of sugar data in determining fruit maturity.

Choosing and Using a Handheld Refractometer

There are two types of handheld refractometers: analog and digital (Fig. 1). They work on the principle that light entering a prism has a unique characteristic. That characteristic is represented by a value on a scale in units known as °Brix. When light enters a dry prism, the field of view in an analog refractometer remains blue (Fig. 2). In a digital refractometer, an error message would appear. Both are indications that the light is not being interfered with as it passes through the prism.

Pure water placed on the refractometer should result in a reading of zero (Fig. 3). A solution containing sucrose (table sugar or fruit juice) placed on the prism surface will change the direction of the light significantly. Depending on the amount of sucrose in solution, the °Brix will range from 0 to 25+ for most agricultural crops. In Figure 4, an analog refractometer displays a reading from a sample that is 17 °Brix.

Handheld analog refractometers are convenient because they do not require an energy source. However, they may not be accurate if used outside the specified temperature range. Older refractometers will give accurate readings

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Vine Lines Now On-line!

In an effort to disseminate information to grape growers and allied industry faster, *Vine Lines* is now available on-line. Interested parties can signup for the e-version at the following link: http://ucanr.org/vinelines

Once signed up, subscribers will be notified via e-mail that the newsletter is available. Archived issues of *Vine Lines* can be found at the same link.

Refractometer Use

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Figure 1. Types of available refractometers. The two on the left are digital and the two on the right are analog.

only when the temperature is at 68ºF (20ºC). Both the refractometer and the sample of juice must be at this temperature. When temperatures are above or below optimal, a corrections table is needed to determine actual ºBrix. Readings can be as much as 0.89 ºBrix lower when the temperature is 50ºF (10ºC) if a correction is not made. If samples are being evaluated at temperatures close to room temperature, the difference is probably of little practical significance. However, if evaluations are being made outdoors in the heat, then it is important to adjust the readings by a given factor provided by the manufacturer. Newer refractometers compensate for fluctuations in temperature, but are still only accurate within a specified range of temperatures. A range between 68-86ºF (20-30ºC) is the most common for temperature compensated (TC) or automatic temperature compensation (ATC) refractometers. Refractometers with larger ATC ranges are available, but are more expensive.

Samples evaluated in the heat on a San Joaquin Valley summer day will result in inaccurate readings. If using a non-ATC refractometer, as the temperature increases, accuracy of the reading will be compromised. Accuracy improves when samples are taken back to a lab or office for processing at room temperature. Figure 5 shows the variability in ºBrix readings from samples evaluated at different times of the day. Note that testing samples during hot weather can give a "false" increase in actual ºBrix. Deciding whether the difference is significant will depend on how close you are to the critical range for decision-making regarding harvest.

If using an analog refractometer, whenever possible, all samples within a specific field or block should be read by one person, since readings are somewhat subjective.

Handheld digital refractometers are convenient, often have ATC, and readings are less subjective. Batteries are needed and should be replaced each season. Juice samples are deposited into a well that allows a light-emitting diode (LED) to reflect light through the prism. A liquid crystal display (LCD) screen displays the ºBrix reading in seconds. As quickly as you can clean the well with water and dry it, the next sample can be tested. In addition to the hot Valley sun affecting digital refractometers when outside of the optimal ATC range, bright light can interfere with accuracy. Shading the sample well will eliminate the interference from sunlight. Whichever style of refractometer you choose, it is important to identify your objective and determine what options are important to you. Analog refractometers are popular with

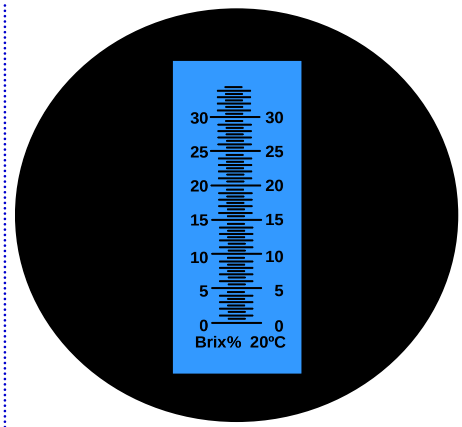

Figure 2. The field of view in an analog refractometer remains blue when only light passes through the prism.

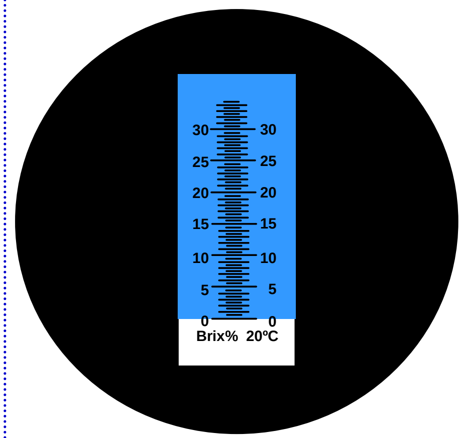

Figure 3. When water is placed on the prism, a contrast line develops at the "0" mark on the scale.

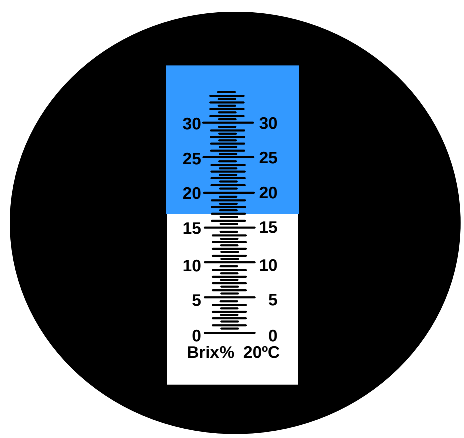

Figure 4. A solution containing sugar will display the percent sucrose in ºBrix units. The sample placed on this prism is displaying 17 ºBrix.

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Refractometer Use

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growers because they are easy to use and relatively inexpensive (approximately $100-200). A digital refractometer will usually result in more rapid readings and more accurate data (approximately $300).

Calibration

Calibrating the refractometer is the first step in evaluating sugar content of fruit. It is an easy but often neglected task. Calibration verifies the zero baseline reading, ensuring that subsequent fruit juice sample readings are accurate. Fruit harvest decisions based on inaccurate sugar readings can impact quality, storage durability and sales. Refractometers should be calibrated at the beginning of each use and, depending on how many samples are being measured, periodically throughout the sampling process.

Proper calibration requires a pure water source and testing solutions of known sucrose concentration. Water allows the user to "zero" the refractometer so fruit juices can be correctly measured. An ideal water source is deionized (DI) or distilled water - water that has been filtered to remove ions such as sodium, calcium, iron and other impurities. In the past, both types of water were available at grocery stores, but are now difficult to find due to production cost. More common now are the many brands of bottled drinking water, which have been filtered using reverse osmosis to remove impurities. Test solutions are needed to calibrate your refractometer. Kits that include solutions with known °Brix values can be purchased from refractometer manufactures, but can be expensive. The following method can be used to make you own calibration test kit, saving yourself hundreds of dollars.

Making a Calibration Test Kit

1. Obtain the following materials (Fig. 6).

   a. 4 bottles of drinking water containing 500ml (16.9 fl oz) each.

   b. A 100-count box of sugar packets with each packet containing 3 grams of sugar. The amount of sugar is specified on the box where nutrition information is listed.

   c. Felt tip marker.

   d. TC or ATC refractometer.

   e. A clean, soft, lint-free cloth.

2. Carefully remove 5 capfuls of water from each bottle to allow room for addition of the sugar.

3. Clearly label each bottle with one of the following designations: 0 packs, 5 packs, 10 packs, 20 packs. *Marking the bottle and cap using a permanent marker will maintain the identity of the bottle contents.* Count out the correct number of sugar packets and place them in front of the bottle with the corresponding number.

4. Hold the packets up to the light to make sure contents are fairly uniform. Although the box may indicate that each sugar packet contains 3 grams of sugar, we found there was a lot of variability in the actual weight of the sugar packets (Figs. 7 and 8). Carefully pour the contents of the specified number of sugar packets into each bottle. The bottle marked with 5 sugar packets will

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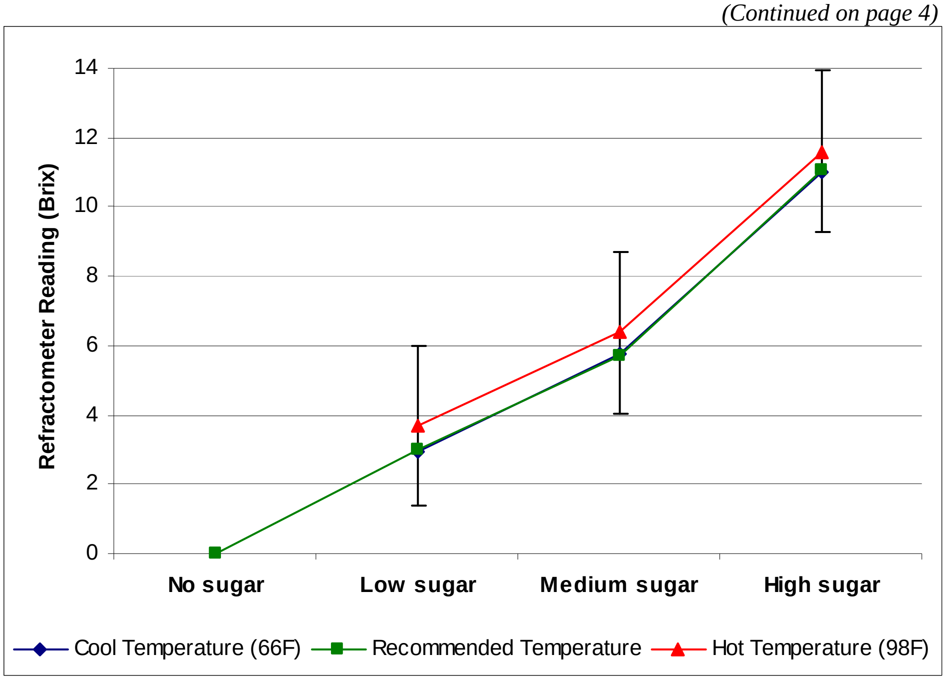

Figure 5. Variability in °Brix readings as a result of solution temperature. Cool temperatures did not have as great an effect on the readings as hot temperatures. Standard deviations associated with the high temperature readings are presented in the graph.

Refractometer Use

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Figure 6. Simple field refractometer calibration test kit.

receive five sugar packets, etc.

5. Secure the cap and vigorously shake each bottle until the sugar is completely dissolved. At the end of this step, four bottles containing 0, 5, 10, and 20 packets of sugar make your calibration test kit.

Steps for Calibration

1. Inspect the refractometer prism for scratches, chips, separations or other aberrations that may interfere with proper readings (Fig. 9). If dusty, rinse with water and wipe with a clean, soft, lint-free cloth.

2. Note the temperature at the time of readings. Most ATC refractometers operate properly in the 68-86ºF range. A laboratory or office at room temperature should be used if outside temperatures exceed the manufacturer's recommended temperature range.

3. Place a few drops of pure water on the prism surface. If it is an analog refractometer, close the prism cover. If bubbles form, gently pressing the cover will remove the bubbles and help disperse the water over the entire surface. For digital refractometers, make sure that bubbles in the well are eliminated prior to making a reading.

4. Hold the refractometer up to natural light or an incandescent bulb to obtain the reading. Looking into the eyepiece, one should see a distinct separation between a blue and white section, often called a "contrast" line. If the contrast line is not directly at zero, then adjust by turning the screw on the top of the refractometer until it reads zero (Fig. 3). Replace the plastic cap after adjusting the calibration screw to prevent water from entering the refractometer. You can adjust the focus by twisting the eyepiece until the scale can be seen clearly. Once the refractometer is calibrated to zero with pure water, dry the surfaces with a clean cloth. Digital refractometers should be calibrated by pressing the *zero* button with water in the well.

5. Place some of the solution from the 5-packet bottle on the prism and close the cover, making sure that the entire surface is filled and void of bubbles. Note the value and write it in Table 1 under *Your Value*. For digital refractometers, place the solution in the well and press the *start* button. Record the value in Table 1. The value will remain on the LED display until the next sample is read.

6. Between samples, clean the refractometer prism surface with pure water and wipe dry.

7. Repeat steps 5 & 6 with bottles marked 10-packet and 20-packet.

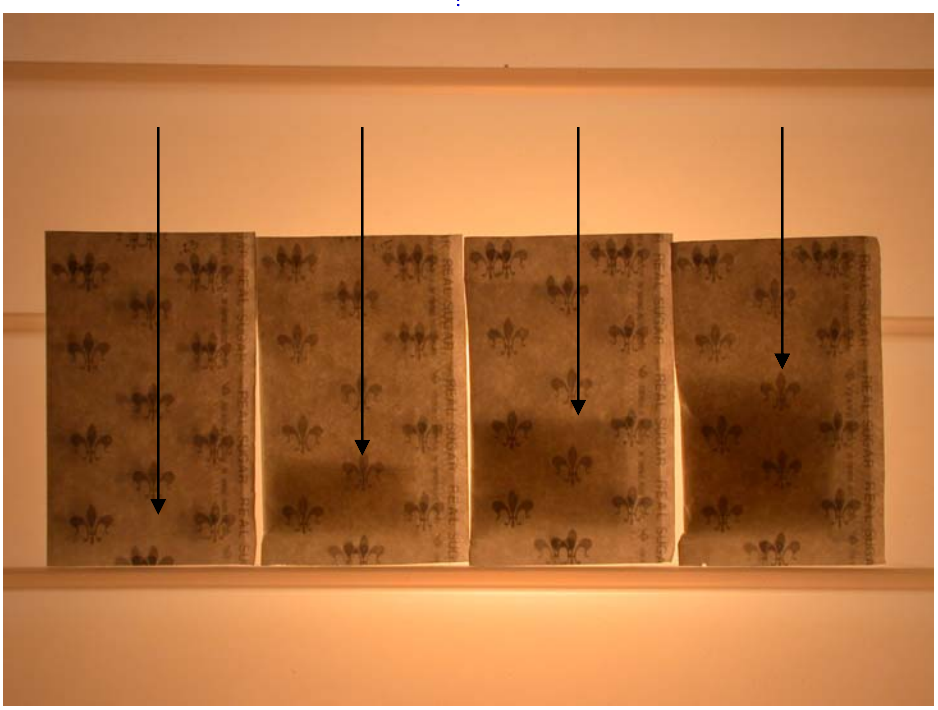

Figure 7. Visual difference in contents of commercial sugar packets. The packet on the far left is empty and the packet on the far right has the expected amount of sugar. Arrows indicate level of sugar in each packet.

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Refractometer Use

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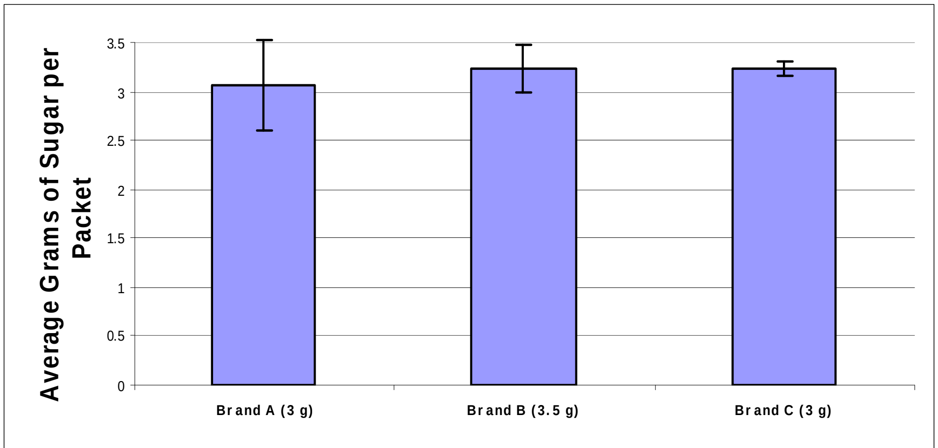

Figure 8. Chart documenting the variability in grams of sugar per packet in commercially packaged sugar. The numbers in parentheses following the Brand designation are the contents specified on the labels. 25 packets of each brand were weighed.

Record the values in Table 1.

8. Compare your values with those in Table 1. If your values are outside the expected range, follow the calibration steps a second time. If they are still outside the range, read the following "Trouble Shooting" section for help.

Trouble Shooting Tips

1. Check to make sure that the bottled water used was unopened/ new.

2. Check to make sure that 500ml water bottles and 3g sugar packets were used.

3. Check to make sure that 5 capfuls of water were removed before adding sugar.

4. Check to make sure that the packets had close to the same amount of sugar in them and that the appropriate number of packets were added to each of the bottles.

5. Check to see if the refractometer is temperature compensating. If it is not, a corrections table is needed to make adjustments. The corrections table is only valid if the temperatures was recorded for each reading.

6. Check to make sure that an ATC refractometer was used within its range of 68-86ºF.

7. Check to make sure that the solution is within the range of the ATC refractometer.

8. Replace the batteries in the digital refractometer at the beginning of each season.

Maintenance

Refractometers are analytical instruments that must be properly maintained for accurate readings. Here are some simple tips to assure accurate readings from season to season.

Refractometers should not be exposed to wet environments. Only the prism surface should be wetted with sugar solution or water. After each reading or before storing the refractometer, the prism should be thoroughly cleaned with water and dried. If the field of view in an analog refractometer becomes cloudy, it most likely has been immersed in water and can only be fixed by a professional technician. Exposing a digital refractometer to excess water may damage the internal electronics.

Do not evaluate solutions that the refractometer is not made for. If your goal is to read sugar samples, do not try to measure saline solutions. Doing so will

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Table 1. Simple field refractometer calibration test kit expected values.

Treatment	Average	Standard Deviation	Range*	*Your Value*
0	0.00	0.020	0-0.1	
5-packet	2.99	0.108	2.8-3.4	
10-packet	5.72	0.262	5.0-6.0	
20-packet	11.04	0.260	10.6-11.8	

*** Refractometers are accurate ±0.2% when used under normal conditions.**

Flavor is the Final Frontier

In terms of quality, scientists are now going where the fruit and vegetable industries haven't ventured before. They are researching the vast and mysterious world of flavor, according to Diane Barrett, the UC Cooperative Extension fruit and vegetable products specialist at UC Davis.

In selecting fruit varieties, comparing cultural practices and studying storage and transportation, scientists have focused on texture, appearance and nutrition, while flavor has been on the backburner, until now.

Barrett and Sue Ebeler, a professor in the UC Davis Department of Viticulture and Enology, recently hosted a workshop at UC Davis to share flavor research with members of the fresh produce and processed fruit and vegetable industry.

"It's important to understand flavor to develop better methods for analyzing food flavor and to understand the effect of cultural practices in agriculture, processing and storage on flavor," Ebeler said.

Flavor is composed of aroma, taste, appearance and mouthfeel. It involves multiple sensory tools and multiple disciplines, said Ebeler, whose research focuses on the development and application of analytical techniques to study wine flavor chemistry. Ebeler uses gas chromatography to dissect aromas that waft from glasses of wine. A tiny fiber is suspended over the wine to collect the volatiles that make up its scent. The scent molecules are sent through a very long, very thin coiled tube lined with a variety of coatings to which certain molecules adhere. A computer analyzes where along the tube compounds are found and produces a graph showing the levels of those compounds.

A glass of chardonnay, for example, might release volatile compounds that are responsible for hints of lime, butter, toast, melon and nuts, Ebeler said. Electronic sniffing has allowed scientists to determine the compounds responsible for these aromas. Butter scent, for instance, can be attributed to diacetyl. However, there are other aromas that are more difficult to pin down. A single compound cannot be credited for aromas like lemon, apple, pear, peach, caramel and pineapple, Ebeler said. They emanate from complex interrelationships of various volatiles.

"We now know there are more than 1,300 volatile compounds identified in alcoholic beverages alone," Ebeler said. "For some of them, such as 'musty cork' or 'rose,' it only takes a few parts per trillion to smell them."

When it comes to certain flavors and aromas, sensory descriptive analysis is the best way to characterize specific attributes. In descriptive analysis, a panel of judges works together to decide upon an objective description of an aroma or flavor. The gas chromatographic profile of the aroma is then also determined, and peaks in the amounts of certain chemicals are compared to the judges' sensory descriptions.

Cabernet sauvignon, for example, may emit aromas of floral, apple, honey, chocolate, dried fig and tobacco to the human judges. By analyzing the samples electronically, high levels of certain chemicals could be indicators of these pleasant scents.

"This is correlation, but it doesn't mean cause and effect," Ebeler said. "Many compounds have little sensory impact and many compounds with important sensory properties can't be measured."

Research aimed at allowing the scientists to develop a complete understanding of the relationship between sensory perception and analytical flavor composition is continuing.

Sensory Studies Require Training

UC Davis professor Hildegarde Heymann has been working in the sensory science arena for 25 years. She notes that, because human taste preferences are highly variable, accurate sensory analysis requires a very large pool of tasters. And since an individual consumer's taste is influenced by culture, psychology, and even genetics, an important step in taste analysis is training.

"We have to teach them the language. We do that with reference standards, such as chemical compounds, food products and verbal descriptions," Heymann said.

In recent taste studies Heymann has conducted with UC Davis students, the subjects compared different varieties of raisins dried either on the vine or on paper trays spread on the vineyard

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Refractometer Use

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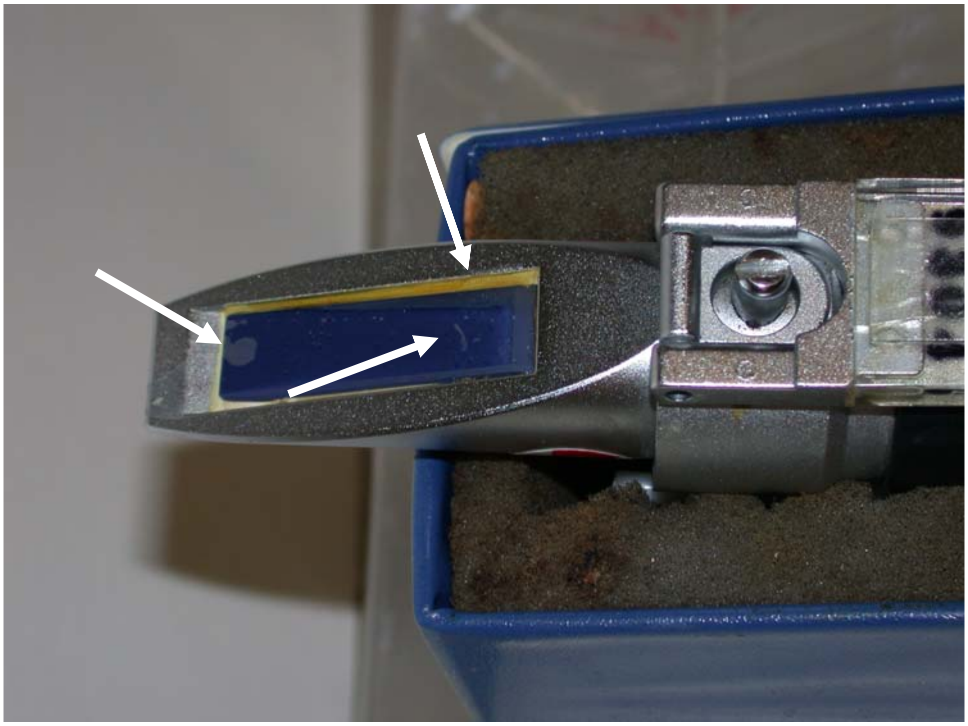

Figure 9. Poorly maintained refractometer with a damaged prism. Scratches, separations, and detached prism noted by arrows.

compromise the instrument. Purchase a refractometer made for the solution you are interested in evaluating.

Handle your refractometer with care. Dropping it can break, scratch, or displace the optics and/or prism. Store your refractometer in a location that has a constant temperature. Storing it in a location that has more than a 5ºF difference each day will severely compromise the optics and prism.

Stephen Vasquez is the UC Cooperative Extension viticulture farm advisor in Fresno County.

Shannon Mueller is the UC Cooperative Extension agronomy farm advisor in Fresno County.

Final Frontier

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floor. Heyman and her staff worked with the testers for weeks to get the group to agree what exactly they would mean when they judged a fruit "astringent" or "gritty" or "sweet." Heymann's taste testing experiments were able to provide helpful results, however, she advises businesses that wish to use sensory analysis to make decisions that could have significant economic consequences to be very careful about gathering their information.

"Consumer panels are easy to conduct, but if they're not the right people, the results are meaningless," Heymann said. "If you work with a product, you probably know too much about it to do an objective study on its sensory properties. If I had to do a consumer panel, I would involve experienced consultants."

The wine industry is ahead of fresh and processed fruit and vegetable industries in the area of flavor analysis, but in an increasingly competitive environment and with more consumers willing to pay a premium for convenient, healthful foods, pursuing sensory studies will be worth the effort, according to Barrett.

"The flavor of fresh produce depends on many factors," Barrett said. "Plant genetics, biochemistry, harvest maturity, postharvest handling and processing all play a role. But producers are beginning to notice that shelf life may not be the same as flavor life and that flavor is worth their attention."

Table Grape BIFS Field Day

Farmers in Kern, Tulare & Fresno Counties are working with UCCE Farm Advisors and the UC Statewide IPM Program on a demonstration project: Biologically Integrated Farming Systems (BIFSO) for table Grapes. The project is documenting pests, yields, and management costs on vineyards managed using practices that reduce risks to people and the environment. Join us to hear what is happening at BIFS project sites and learn about management strategies to consider in your vineyard.

Topics will include:

- New advances in control of vine mealybug
- Managing black widow spiders
- Update on volatile organic compound (VOC) emissions in herbicide use
- Disease

Time: June 28, 2007
8:30am—10:30am

For location and directions, please visit our events calendar at: http://cefresno.ucdavis.edu/

For more information, contact: Walt Bentley at (559) 288-1517 or walt@uckac.edu

Grape Day at the University of California Kearney Ag Center

Grape growers, packers, and others interested in grapes, are encouraged to attend Grape Day at the University of California's Kearney Agricultural Center (KAC), on 14 August 2007. Grape Day is a biennial event where scientists who've conducted research at the KAC present some of their findings to the public. This year's event will truly showcase the broad range of applied research being conducted at the KAC on behalf of valley grape growers.

- How glyphosate applications affect root death and plant parasitic nematodes
- New nematode resistant grape rootstock selections for San Joaquin Valley vineyards
- Glyphosate-resistant and glyphosate susceptible horseweed in vineyards
- Botryosphaeria fungi and canker diseases of grapevines
- New winegrape cultivars for the San Joaquin Valley
- Refractometer calibration, use, and maintenance
- Sensory characteristics of Merlot wines subjected to irrigation or leaf removal treatments

Time: August 14, 2007
8:30am – 12:00pm
Kearney Agricultural Center
9240 S. Riverbend Avenue
Parlier, CA, 93648.

For more information, contact Matthew Fidelibus

(559) 646-6510.

Calendar of Events

Local Meetings and Events

Table Grape BIFS Field Day
June 28, 2007
8:30 a.m.—10:30 a.m.
For location please visit our events calendar at:
http://cefresno.ucdavis.edu/

KAC Grape Day
August 14, 2007
8:30 a.m.— 12:00 p.m.
Kearney Ag Center
9240 S. Riverbend Avenue
Parlier, CA 93648

U.C. Davis University Extension Meetings

(800) 752-0881

Winegrape Irrigation: Principles, Practices and Consequences
July 9, 2007
9:00 a.m.— 4:00 p.m.
Da Vinci Building, 1632 Da Vinci Ct.
Davis, CA
Instructor: Terry Prichard
Section: 071VIT223

Introduction to Sensory Evaluation of Wine
July 14, and 15, 2007
9:00 a.m. — 4:00 p.m.
Da Vinci Building, 1632 Da Vinci Ct.
Davis, CA
John Buechsenstein
Section: 071VIT215

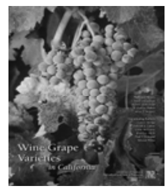
Winegrape Variety Workshop—Identification, Production, Culture and Clones
August 13, and 14, 2007
8:30 a.m.— 4:00 p.m.
Viticulture Field House, Hopkins Road
Instructor: Andrew Walker
Section: 071VIT222

Topics in Wine Analysis: Color and Tannin Measurement
August 15, 2007
8:30 a.m. — 4:00 p.m.
7 Wellman Hall, West Quad
Davis, CA.
Instructor: Michael Ramsey
Section: 071VIT224

Publications from the University of California

Weeds of California and other Western States, 2007
ANR Publication 3488
Price - $100.00 + tax and shipping

This easy-to-use guide is the most comprehensive guide available on weeds in the Western United States. Package includes a CD of all of the photographs from the book.



Wine Grape Varieties in California, 2003
ANR Publication 3419
Price - $30.00 + tax and shipping

A comprehensive variety publication. Covers all the grape growing districts in California, highlighting 36 major varieties.

Order Form

Publication	Qty.	Price	Subtotal
Weeds of California		$100.00	
Wine Grape Varieties		$ 30.00	

Shipping – USA Only

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$40—49.99	$9
$50—79.99	$10
$80—99.99	$12
$100+	$15

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Vine Lines

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