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University of California
Agriculture and Natural Resources
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Cooperative Extension Sutter-Yuba Counties

Sacramento Valley Almond News

April, 2012

Nitrogen Use Efficiency in Almonds

Franz Niederholzer, UCCE Farm Advisor, Colusa/Sutter/Yuba Counties

Nitrogen (N) is a key mineral nutrient in almond production. Nitrogen deficiency reduces kernel yield per acre, and profitable almond production requires significant N input each year a large crop is set. Nitrogen is also an environmental contaminant, harmful to both air and water quality.

Efficient N management means matching N inputs (fertilizer, compost, etc.) to orchard N needs through the season to grow the largest crop in the cleanest way possible. How best to do this? Some practices are known, others are the subject of current research. Current work by research teams lead by University of California Professor Patrick Brown and funded by public (USDA, State of CA) and private (Almond Board of CA, fertilizer industry) dollars is helping growers and PCA/CCAs get a clearer picture of efficient almond orchard N management. The study site is a mature, commercial 50% Nonpareil/50% Monterey orchard on Nemaguard rootstock near Belridge in Kern County. Information on this overall project is available on the web at: http://ucanr.org/sites/scri/. Click on "Outreach" to see recent presentations and publications on this topic.

For now, growers and PCA/CCAs may want to consider the 4Rs of good nutrient management -- Right Source, Right Rate, Right Timing and Right Placement – when planning fertilizer use, especially N fertilizer. Here's a quick review of these four key factors in nitrogen management in almonds.

Right Source. There a number of N sources available to growers – urea, UAN 32, ammonium sulfate, CAN 17, calcium nitrate as well as composts and organic fertilizers. Liquid materials such as UAN32 and CAN17 are popular. So far, at the Belridge experiment, there has been no difference in yield between equal annual amounts of N as UAN 32 or CAN17. So, as far as I have seen, material choice is really a function of price per unit N and local needs. Ammonium sulfate and urea are acid producing, as the ammonium from these materials is converted to nitrate in the soil. Fertilizer nitrate adds no acid to the soil. Ammonium and urea can be lost as ammonia gas if applied to the soil surface without rapid (1-2 days, max) incorporation. Nitrate doesn't volatilize. Urea and nitrate will move with water during an irrigation event and can be moved below the root zone with excess water – either from rain or irrigation. Ammonium is less mobile during and shortly after application – until converted to nitrate. This process usually takes several weeks.

Right Rate. The annual fertilizer rate in a mature, producing orchard is mostly determined by crop size, although some N is needed to grow new shoots and spurs for future crops. In mature, producing almond trees, the crop contains the largest percentage of the whole tree nitrogen (and potassium) content. One thousand pounds of almond kernel yield contains 50-75 pounds of nitrogen, depending on the amount of N supplied to trees, with higher nut N levels in trees receiving high N rates. A removal rate of 60 lbs N/1000 lb nut meat yield is suggested by Dr. Brown's team as the number to use when

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Submitted by:

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estimating annual N demand from a crop load estimate. At the Belridge study site, with excellent irrigation management practices in use, annual applications of 275 lbs fertilizer N produced 3500-4500 lbs of Nonpareil nut meats/acre in 2009-2011. In those same years, a higher rate (350 lbs N/acre/year) produced no more nuts, while lower rates (125 or 200 lbs N/acre/year) produced good crops, but significantly less than the 275 lb N/acre/year rate. Other factors (weather, summer defoliation, etc.) besides N can limit your production so be sure your applied rate is appropriate for *your* crops demand.

Right Timing. Almond nuts and shoots use the most N (80% of annual demand) between bloom and mid-June. As nut and shoot growth slows, trees use less N in late summer/early fall. Deciduous trees essentially absorb no N between leaf drop and leaf out. To match fertilizer delivery with tree N use, Dr. Brown's group recommends delivering fertilizer N at four different timings and amounts through the season – February or March (20% of total annual N input), April (30%), June (30%) and September - October (20%). The last application should be applied as soon as possible postharvest, and potentially skipped if significant leaf loss has occurred at harvest. Overall, for the best returns and to benefit the environment, Sacramento Valley almond growers should apply most of their annual fertilizer N input in spring/early summer and do everything possible to limit the amount of nitrate in the soil as winter -- and the storm season -- approaches.

Right Placement. Fertigation delivers fertilizer to active roots. As long as irrigation is managed to deliver only needed water, fertigation is a highly efficient method of fertilization. Orchards using flood or solid set sprinkler irrigation systems should apply fertilizer N in the herbicide strips along the tree row, not as a general broadcast application. There are more almond tree roots in the tree rows than out in the middles, where competition with weeds for water and nutrients plus compaction from equipment traffic reduces tree root growth.

Almond pruning wound cankers

Joe Connell, UCCE Farm Advisor, Butte County

Almond pruning wound cankers can become a problem when recent pruning cuts are followed fairly closely by heavy extended rainfall that spreads fungus spores and creates conditions conducive to infection of the pruning wounds.

The beginning of January was a great for accomplishing a lot of field work such as pruning first and second leaf almond trees because conditions were warm and dry. Fieldwork came to a halt on January 19th when storms brought heavy rains with over 5 inches of rain falling in the next five days over portions of the Sacramento Valley. These wet saturated conditions created nearly perfect conditions for the establishment of aerial phytophthora pruning wound cankers when this rainy period followed freshly made pruning wounds. *Phytophthora syringae* was the most common fungus isolated from pruning wound cankers during cool wet conditions in the early 1980s.

P. syringae is well adapted for growth and development in almond tissue under the common winter conditions of the Sacramento valley, mild temperatures and high rainfall. In subsequent research, *P. syringae* was found to be virulent in branch cankers over a broad range of temperatures from 36^{o} to 68^{o} F with lower temperatures resulting in larger cankers. Phytophthora cankers can quickly expand from an infection site at pruning wounds extending to more than 6 inches within three weeks of infection. As spring progresses, amber colored gum balls extruding through the bark are frequently seen at the cankers margin.

These cankers die out as temperatures warm during late spring and by June the fungus cannot normally be isolated. The inability to isolate the fungus later in the season is not surprising since *P. syringae* will not grow at 80^{o} F or above. This temperature is frequently exceeded during May and June in the central valley.

In subsequent seasons after the cankers have died out and gumming has disappeared, the dead area will appear as a sunken canker with wound healing occurring from around the canker margins. If these cankers are on larger wood they may have little impact on the vigor of the branch. If they occur on young trees where competing scaffolds have

been removed or if multiple cankers girdle a larger branch then death of the tree or branch above the cankers can occur.

Dried gum observed around inactive cankers in June through September can lead to confusion between this disease and other warm weather canker diseases such as those caused by *Ceratocystis fimbriata* and *Botryosphaeria dothidea* fungi. Both of these fungi have also been documented to occasionally invade pruning wounds under the right conditions. Cankers caused by these fungi are sometimes slower growing but they can be perennial cankers that eventually girdle and kill branches. If cankers are on a branch that can be removed by pruning that is the best way to eliminate the problem. *C. fimbriata* cankers are usually small diamond shaped cankers around the pruning wound. *B. dothidea* cankers have been observed to grow very fast surrounding pruning wounds made near the crotches of young trees. In recent research, a wide range of fungicide treatments were applied to *B. dothidea* trunk cankers and to healthy tree trunks to try and protect them from infection. The fungicide treatments were not successful in restricting canker size of existing cankers nor did they protect the healthy trees from new infections during the season when treatments were applied.

ALMOND: TREATMENT TIMING

Note: Not all indicated timings may be necessary for disease control.

Disease	Dormant	Bloom			Spring[1]		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Alternaria	----	----	----	----	----	++	+++	+++
Anthracnose[2]	----	++	+++	+++	+++	+++	+++	++
Brown rot	----	++	+++	+	----	----	----	----
Green fruit rot	----	----	+++	----	----	----	----	----
Leaf blight	----	----	+++	++	+	----	----	----
Scab[3]	++	---	---	++	+++	+++	+	---
Shot hole[4]	+[5]	+	++	+++	+++	++	----	----
Rust	----	----	----	----	----	+++	+++	+[6]

Rating: +++ = most effective; ++ = moderately effective; + = least effective; ---- = ineffective

[1] Two and five weeks after petal fall are general timings to represent early postbloom and the latest time that most fungicides can be applied. The exact timing is not critical but depends on the occurrence of rainfall.

[2] If anthracnose was damaging in previous years and temperatures are moderate (63°F or higher) during bloom, make the first application at pink bud. Otherwise treatment can begin at or shortly after petal fall. In all cases, application should be repeated at 7- to 10-day intervals when rains occur during periods of moderate temperatures. Treatment should, if possible, precede any late spring and early summer rains. Rotate fungicides, using different fungicide classes, as a resistance management strategy.

[3] Early treatments (during bloom) have minimal effect on scab; the 5-week treatment usually is most effective. Treatments after 5 weeks are useful in northern areas where late spring and early summer rains occur. Dormant treatment with liquid lime sulfur improves efficacy of spring control programs.

[4] If pathogen spores were found during fall leaf monitoring, apply a shot hole fungicide during bloom, preferably at petal fall or when young leaves first appear. Re-apply when spores are found on new leaves or if heavy, persistent spring rains occur. If pathogen spores were not present the previous fall, shot hole control may be delayed until spores are seen on new leaves in spring.

[5] Dormant copper treatment seldom reduces shot hole infection but may be useful in severely affected orchards and must be followed by a good spring program.

[6] Treatment in June is important only if late spring and early summer rains occur.

ALMOND: FUNGICIDE EFFICACY

Fungicide	Resistance risk (FRAC)[1]	Brown rot	Jacket rot	Anthracnose	Shot hole	Scab[3]	Rust[3]	Leaf blight	Alternaria leaf spot[3]	PM-like[5]	Silver leaf
Adament	high (3/11)[3]	++++	++	++++	+++	+++	+++	ND	++	+++	----
Bumper/Tilt[4]	high (3)	++++	+/---	++++	++	++	+++	ND	++	+++	----
Distinguish**	high (9/11)	++++	++++	++++	++	ND	ND	ND	ND	ND	----
Indar	high (3)	++++	+/---	+++	++	++	NL	ND	+	ND	----
Inspire[4]	high (3)	++++	+	ND	++	+++	ND	ND	+++	+++	----
Inspire Super*	high (3/9)	++++	++	ND	++	+++	ND	ND	+++	ND	----
Luna Sensation*	medium (7/11)[3,7]	++++	++++	++++	++++	++++	+++	ND	+++	+++	----
Pristine	medium (7/11)[3,7]	++++	++++	++++	++++	++++	+++	ND	+++	+++	----
Quash	high (3)	++++	++	++++	++	+++	++++	ND	+++	+++	----
Quadris Top*	medium (3/11)[3]	++++	++++	++++	+++	++++	+++	ND	+++	+++	----
Quilt Xcel	medium (3/11)[3]	++++	++++	++++	+++	++++	+++	ND	+++	+++	----
Rovral + oil[8]	low (2)	++++	++++	----	+++	+/---	++	ND	+++[9]	ND	----
Scala[3]	high (9)[3, 7]	++++	++++	ND	++	----	ND	ND	+	----	----
Tebuzol (Elite*)	high (3)	++++	+/---	+++	++	++	+++	ND	+	ND	----
Topsin-M/T-Methyl/ Thiophanate-Methyl[2]	high (1)[2, 7]	++++	++++	----	----	+++[8]	+	+++[6]	----	++	----
Vangard	high (9)[3, 7]	++++	++++	ND	++	----	ND	ND	+[9]	----	----
Abound[4]	high (11)[3, 7]	+++	----	++++	+++	++++	+++	+++	+++[10]	+++	----
Elevate	high (17)[7]	+++	++++	----	+	ND	ND	ND	ND	ND	----
Gem[4]	high (11)[3, 7]	+++	----	++++	+++	++++	+++	+++	+++[10]	+++	----
Laredo	high (3)	+++	----	++	++	----	+	+++	----	+++	----
Rovral/Iprodione/Nevado	low (2)	+++	+++	----	+++	----	----	ND	++[9]	----	----
Bravo/Chloro-thalonil/Echo /Equus[11,12]	low (M5)	++	NL	+++	+++	+++	NL	NL	NL	----	----
Captan[4,12]	low (M4)	++	++	+++	+++	++	----	+++[6]	+	----	----
CaptEvate*	low (M4/17)	+++	+++	+++	+++	+++	----	+++	+	----	----
Maneb**	low (M3)	++	+	++	++	++	+++	++	----	----	----
Ph-D/Endorse*	medium (19)	++	++	----	++	----	ND	ND	+++	----	----
Rally[13]	high (3)	++	----	++	+/---	----	+	+++	----	+++	----
Ziram	low (M3)	++	+	+++	+++	+++	----	++	+	----	----
Copper[14]	low (M1)	+/---	+/---	----	+	+[15]	----	----	ND	----	ND
Copper + oil[14]	low (M1)	ND	ND	----	+	+++[15]	----	----	ND	----	ND
Lime sulfur[12]	low (M2)	+/---	NL	----	+/---	++[15]	++	NL	NL	----	NL
Sulfur[4,12]	low (M2)	+/---	+/---	----	----	++	++	----	----	+++	----
PlantShield	low	----	----	----	----	----	----	----	----	----	+++***

Rating: ++++ = excellent and consistent; +++ = good and reliable; ++ = moderate and variable; + = limited and/or erratic; +/--- = minimal and often ineffective; ---- = ineffective; NL = not on label; ND = no data

*** Registration pending in California**

****Not registered, label withdrawn or inactive**

*** Section 24C (special local needs) registration approved in California.

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Fungicides with a different group number are suitable to alternate in a resistance management program. In California, make no more than one application of fungicides with mode of action Group numbers 1, 4, 9, 11, or 17 before rotating to a fungicide with a different mode of action Group number; for fungicid with other Group numbers, make no more than two consecutive applications before rotating to fungicide with a different mode of action Group number.

[2] Strains of the brown rot fungi *Monilinia laxa* and *M. fructicola* resistant to Topsin-M and T-Methyl have been found in some California almond orchards. MBC-resistant strains of the jacket rot fungus, *Botrytis cinerea* and powdery mildew fungi, have been reported in California on crops other than almond and stone fruits and may have the potential to develop in almonds with overuse of fungicides with similar chemistry. MBC-resistant strai of the scab fungus, *Cladosporium carpophilum*, have been found in California.

[3] Field resistance of *Alternaria* sp. and *Cladosporium carpophilum* to QoI and SDHI fungicides has been detected in almond orchards. AP-resistant populations of *Monilinia* spp. have been found on other stone fruit crops in California.

[4] Of the materials listed, only sulfur, Abound, Gem, and some of the DMI fungicides (FRAC Group No. 3) are registered for use in late spring and early summer when treatment is recommended.

[5] PM-like refers to a powdery mildew-like disease on almond fruit that is managed with fungicides with activity against powdery mildew fungi.

[6] Excellent control obtained when combinations of Topsin-M or T-Methyl and Captan are used.

[7] To reduce the risk of resistance development start treatments with a fungicide with a multi-site mode of action; rotate or mix fungicides with different mode of action FRAC numbers for subsequent applications, use labeled rates (preferably the upper range), and limit the total number of applications/season.

[8] Oil recommended is a "light" summer oil, 1-2% volume/volume.

[9] Not registered for use later than 5 weeks after petal fall.

[10] Efficacy reduced at high temperatures and relative humidity; experimental for Alternaria.

[11] Bravo Ultrex, Bravo WeatherStik, Echo, Echo Ultimate, and Chlorothalonil are currently registered.

[12] Do not use in combination with or shortly before or after oil treatment.

[13] Efficacy is better in concentrate (80-100 gal/acre) than in dilute sprays.

[14] The low rates necessary to avoid phytotoxicity in spring reduce the efficacy of copper.

[15] "Burns out" scab twig lesions when applied at delayed dormant.

ALMOND: SUGGESTED DISEASE MANAGEMENT PROGRAMS BY FUNGICIDE FRAC[1] GROUPS

Note: Not all indicated timings may be necessary for disease control (*see* Treatment Timing Table). If treatments are needed based on host phenology, weather monitoring, inoculum models, or environmental-disease forecasting models, suggested fungicide groups are listed for each timing.

How to use this table:

1. Identify the disease(s) that need(s) to be managed. Know the disease history of the orchard especially from the previous season.
2. Select one of the suggested fungicide groups. *Numbers separated by slashes are pre-mixtures, whereas numbers grouped by pluses are tank mixtures.* If several diseases need to be managed, select a group that is effective against all diseases. Refer to fungicide efficacy table for fungicides belonging to each FRAC group. Group numbers are listed in numerical order within the suggested disease management program.
3. Rotate groups for each application within a season and, if possible, use each group only once per season, except for multi-site mode of action materials (e.g., M2) or natural products/biological controls (NP/BC).

Disease	Dormant	Bloom			Spring		Summer	
		Pink bud	Full bloom	Petal fall	2 weeks	5 weeks	May	June
Alternaria	----	----	----	----	----	2	3, 3/11 7/11 11 19	3, 3/11 7/11 11 19
Anthracnose	----	3, 3/11	3, 3/11 7/11 11	3, 3/11 11 M3 M4	3, 3/11 7/11 11 M3 M4	3, 3/11 7/11 11 M3 M4	3, 3/11 7/11 11 M3 M4	3, 3/11 7/11 11 M3 M4
Brown rot	----	1[2] 2 (+oil) 3, 3/11 9	1[2] 2 (+oil) 3, 3/11 9 7/11 11	1[2] 2 (+oil) 9 7/11	----	----	----	----
Green fruit rot	----	----	1[2] 2 (+oil) 9 7/11	----	----	----	----	----
Leaf blight	----	----	1[2] 2 3, 3/11 11	1[2] 2 3, 3/11 11 M3 M4	3, 3/11 11 M3 M4	----	----	----
Scab[4]	M1+oil, M2[3]	----	----	1[2] 7/11[2] 11[2] M3 M4 M5	1[2] 7/11[2] 11[2] M3 M4 M5	3, 3/11 7/11[2] 11[2] M2[3] M3 M4	M2[3] M4	----
Shot hole	M1	2 3, 3/11 9	2 3, 3/11 7/11 9 11	2 3, 3/11 7/11 9 11	7/11 11 M3 M4 M5	7/11 11 M3 M4 M5	----	----
Rust	----	----	----	----	----	3, 3/11 7/11 11 M3	3, 3/11 7/11 11	3, 3/11 7/11 11

[1] Group numbers are assigned by the Fungicide Resistance Action Committee (FRAC) according to different modes of actions (for more information, see http://www.frac.info/). Group numbers are listed in numerical order within the suggested disease management program. Fungicides with a different group number are suitable to alternate in a resistance management program. Refer to the fungicide efficacy table for fungicides belonging to each FRAC group.

[2] Strains of *Monilinia fructicola* and *M. laxa* resistant to Topsin-M, and T-Methyl are present in some California almond orchards. Resistant strains of the jacket rot fungus, *Botrytis cinerea*, and powdery mildew fungi have been reported in California on crops other than almond and stone fruits and may have the potential to develop in almond with overuse of fungicides with similar chemistry.

[3] Use liquid lime sulfur in dormant applications and wettable sulfur at and after pre-bloom.

[4] Apply petal fall treatments based on twig-infection sporulation model.

35th Annual Nickels Field Day

Thursday, May 3, 2012
Nickels Soil Lab
Greenbay Avenue, Arbuckle

8:30 a.m. — **Registration**

Coffee and Danish provided by Farm Credit Services of Colusa-Glenn, ACA

9:00 a.m. — **Field Topics:**

Hedgerow Chandler walnut pruning trial.
Carolyn DeBuse, UC Farm Advisor, Solano/Yolo Counties
Janine Hasey, UC Farm Advisor, Sutter/Yuba Counties

Howard walnut hedging trial results.
Bruce Lampinen, Extension Specialist, Plant Sciences Department, UC Davis

Does increasing Nonpareil percentage improve per acre returns?
Joe Connell, UC Farm Advisor and County Director, UCCE Butte Co.

Spraying herbicide in orchard middles.
Brad Hanson, Extension specialist, Plant Sciences Department, UC Davis

Self-fertile almond varieties.
Tom Gradziel, Professor, Plant Sciences Department, UC Davis

New almond leaf sampling practices.
Sebastian Saa, PhD candidate, Plant Sciences Department, UC Davis

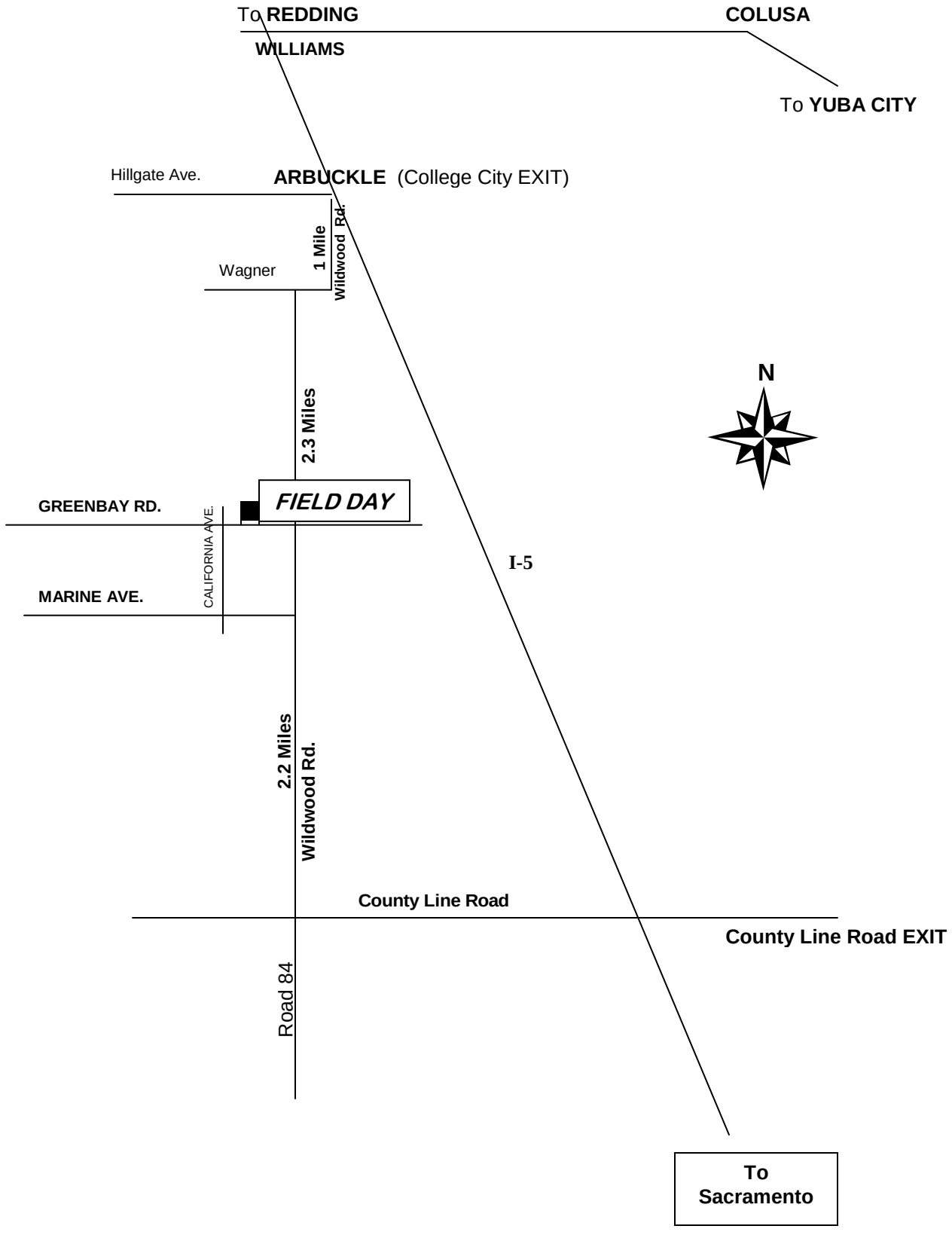
Nonpareil on peach and plum rootstocks.
Bill Krueger, UC Farm Advisor, UCCE Glenn Co.

Introduction to foliar nitrogen sprays in almond.
Franz Niederholzer, UC Farm Advisor, Colusa/Sutter/Yuba Counties

12:15 pm — **Lunch** by reservation, proceeds to benefit the Pierce FFA Program

Luncheon Speaker - Jeff Sutton, General Manager, Tehama Colusa Canal Authority.

PCA and CCA credits pending


To REDDING
COLUSA
WILLIAMS
To YUBA CITY
Hillgate Ave.
ARBUCKLE (College City EXIT)
1 Mile
Wildwood Rd.
Wagner
N
2.3 Miles
FIELD DAY
GREENBAY RD.
CALIFORNIA AVE.
I-5
MARINE AVE.
2.2 Miles
Wildwood Rd.
County Line Road
County Line Road EXIT
Road 84
To
Sacramento

Luncheon Reservation Form

Cost: **$12.00/person (Prepaid Reservation)**
$15.00/person at the door

Make checks payable to: **Pierce High School**

Mail to: **Cooperative Extension**
P.O. Box 180
Colusa, CA 95932

Name:		
Address:		
City:	**State:**	**Zip:**
Email:		**Phone:**

Name(s) of Attendees(s):	
Total Amount Enclosed:	**$**

Please return this form & your check by April 27th to receive the discounted price.