Topics in Subtropics Newsletter

University of California Cooperative Extension
Fresno - Kern - Madera - Riverside - San Bernardino - San Diego - San Luis Obispo - Santa Barbara - Tulare - Ventura Counties

News from the Subtropical Tree Crop Farm Advisors in California

Volume 2, No. 3

July - September 2004

Neil O'Connell is the editor for this issue of the newsletter.

This newsletter is available online at http://cetulare.ucdavis.edu or any of the CE office websites listed on page 9

Please let us know if there are specific topics that you would like us to address in subtropical crop production. If you would like to change information on your mailing label please call or send an email message to the farm advisor in the county where you live. In some counties this newsletter is sent electronically. Phone numbers and email addresses can be found at the end of this newsletter.

IN THIS ISSUE:

Topic

UPCOMING MEETINGS

Citrus Research - Growers' Seminars 2004
CRB & UC Cooperative Extension

Chico: Wednesday, October 27
9:00 a.m. – 1:30 p.m.
Chico Masonic Family Center, 1110 W. East Avenue, Chico

- *Identification of insect pests of citrus and the damage they do (in-depth session)*
- *Principles of frost protection*
- *Using new budget calculator software*

After the research seminar, the local area citrus farm advisors will lead a group discussion on marketing.

Pala: Tuesday, November 2
9:00 a.m. – 1:30 p.m.
Pala Casino Hotel, 11154 Highway 76, Pala

- *Using compost/mulch (including a case study)*
- *Citrus leafminer: what to expect*
- *Glassy-winged Sharpshooter impact on citrus*
- *Topworking: pros and cons, what you need to know (featuring an industry panel)*
- *An after-lunch bonus session on using new budget calculator software*

Indio: Wednesday, November 3
9:00 a.m. – 1:30 p.m.
Indian Palms, 48630 Monroe Street, Indio

- *Using compost/mulch (basic background information, pros and cons, local area examples)*
- *Glassy-winged sharpshooter impact on citrus and update on Pierce's disease in desert grapes*
- *Information on lemon varieties for the desert*
- *Using new budget calculator software*

Deficit Irrigation

Neil O'Connell, Farm Advisor
University of California Davis
nvoconnell@ucdavis.edu

Deficit irrigation research by Dr.David Goldhamer has yielded some interesting results in navel oranges. In the original trial on mature, vigorous Frost Nucellar navels on a sandy loam soil, applied water was reduced by varying amounts and at different times during the irrigation season depending upon the treatment imposed. Regulated deficit irrigation is applying a fixed % less than the full water requirement of the tree during a specific period in the irrigation season.

The fully irrigated control trees received a volume of water estimated to be the tree water requirements based upon size and current weather conditions –using the current water requirements of a pasture grass (Eto cimis station) multiplied by a crop factor for mature citrus which is 0.65. The objective of the trial was to determine if the volume of applied water could be reduced by varying amounts and at different times during the irrigation season compared to a fully irrigated control without a loss in yield or quality and perhaps improved peel appearance. Measurements were made of fruit growth during the season and of yield and fruit quality at harvest; the amount of water applied with each treatment was measured as well. Research conducted over the years has indicated that citrus was sensitive to reduced irrigation particularly at petal fall and during early fruit development with loss in yield or fruit size.

FROST NUCELLAR NAVELS

Irrigation treatment	1998-2000 mean applied water[1] (inches)	Deficit irrigation period	Deficit irrigation rate (% control)
T1 Control	31.6		-
T2	25.4	thru May 31	0
T3	23.7	May 16-Jul 15	25
T4	27.9	May 16-Jun 30	50
T5	26.3	May 16-Jul 15	50
T6	23.3	Jul 1-Jul 31	0
T7	27.0	Jul 1-Jul 31	25
T8	27.8	Jul 1-Jul 31	50
T9	23.2	Jul 1-Aug 15	25
T10	26.5	Jul 1-Aug 15	50
T11	26.1	Jul 1-Aug 30	50
T12	27.0	Oct 16-Dec 15	0
T13	24.7	Season	75
T14	28.7	Season	85
Rain (inches)[3]	8.3		
ETo (inches)[4]	52.9		
ETc (inches)[5]	34.4		

[1]From last irrigation in previous calendar year to harvest in subsequent year.
[2]During deficit irrigation period. MPa x 10 equals measurements in bar units.
[3]Mean from after harvest of period year to just harvest of subsequent year.
[4]Mean for calendar years.
[5]Assuming crop coefficient (Kc) of 0.65.

The current study indicated that where deficit irrigation was applied, a slowing in growth rate of the fruit was observed compared to the fully irrigated tree, but when full irrigation was resumed at the end of the treatment period, accelerated growth occurred compared to the control trees. Yield at harvest was not significantly different among any of the reduced irrigation treatments compared to the fully irrigated control trees. There was also no difference in number of fruit per tree or packable cartons among the treatments compared to the control. An additional result was that there was significantly less creasing of the peel in two of the treatments--T2 and T3-- compared to the fully irrigated trees. Both of these treatments imposed stress early in the season and reduced applied water by 6.2 and 7.9 inches, respectively. This equates to 19.6 and 22.8% less applied water than the fully irrigated control. This research demonstrated that less than the full water requirements of the tree can be applied at specific times during the fruit development period under controlled and known conditions without a loss in yield.

Ongoing research on Lane Late navels is being conducted with the object of reducing granulation by regulating fruit size for an optimum fruit size at harvest. Fruit held late for harvest frequently results in a significant portion of the fruit being large. Historically large fruit have a higher percentage of the fruit with granulation. This fruit may be less than optimum size (too large) for current market conditions as well. Based upon the previous regulated deficit irrigation study the object of the current trial is to regulate size based upon imposed stress by applying less than full irrigation during specific periods in the irrigation season that is early, mid and late season stress.

Lane Late Navels
RDI Regimes Being Tested

Treatment	Stress Period	Irrigation Management
1	Early season	Delay irrigation; deficit thru Jun
2	Mid season	Deficit in Jul-Sep
3	Late season	Deficit Sep-Nov
4	Season long	Interactive deficit
5	Control	Full irrigation

Deficit irrigation generally at 50% of Control

Less water is applied than required by a fully irrigated tree for the period, and growth of the fruit is monitored compared to the fully irrigated tree. Adjustments are made in applied water based upon the growth of the fruit in the stress tree as well as measured tree water status (pressure chamber) compared to the fully irrigated control. The same type of response to the deficit irrigation that occurred with the Frost Nucellar has been observed. A slowing of growth under the deficit irrigation, then accelerated growth with resumption of full irrigation. However, this study imposes stress over longer periods that the previous study and thus, the desired reductions in fruit size at harvest have occurred in all but the T1 treatments. The first year of the study, when fruit loads were relatively high, showed that early season stress reduced granulation (6.5% for all sizes vs. 17% for the control) with no effect on size. Continuous stress reduced both granulation (mean of 3.8 for all sizes vs. 17% for the control) and fruit size. In the second study year with lower fruit loads, there was no reduction in fruit load but fruit size was reduced to a greater extent in the mid, late summer, and continuous stress treatments. This reduced the percentage of unwanted very large size (24 and 32 count) fruit such that revenue to the grower was higher by from $1300 to $3000 per acre, depending on whether 24s and 32s were considered marketable.

Deficit irrigation imposes a level of stress on the tree related to the amount of water that the tree is shorted compared to a fully irrigated tree. The tolerance of the tree to this stress is related to the vigor of the tree, the period in the fruit development cycle, weather conditions, and how long the stress continues, and the magnitude of the stress. Under the conditions of these studies the level of stress imposed is carefully monitored and the deficit irrigation treatments are under known conditions and are carefully controlled. Where conditions are not known by the grower the trees may already be under some stress, the vigor of the trees may not be high; the irrigation system may not be uniform and therefore not delivering the expected volume. Attempting deficit irrigation under these circumstances runs the risk of reducing yield perhaps seriously as well as fruit size.

Topworking or Replanting, A Grower's Perspective?

Larry Lindgren, Grower
Ben Faber, Farm Advisor

There are many changes going on in the citrus industry and one opportunity is the conversion of an orchard to another variety of citrus. If this is a consideration, then the question becomes one of whether the orchard should be topworked or replanted with new nursery trees. If the trees are healthy and under 20 years of age (it is possible to topwork older trees) and the new scion is compatible with the interstock or rootstock, then topworking can come into production sooner than a new replant. If the planting

density needs to be changed or serious soil preparation or a new irrigation system needs to be installed, then replanting might be the preferred choice.

The chance to convert is also dependent on the availability of new trees and budwood. New varieties can often be in short supply. It's best to make sure that for either option that the material is there. For topworking, T-budding is more conservative of material than stick grafting. If topworking is chosen, then it must be decided whether to graft the scaffold branches or the stump. Stump grafting makes for a lower tree, but scaffold grafting reduces the risk of losing the topworked tree from damage to the graft from birds, pests, wind or frost.

It is often assumed that topworking is cheaper than replanting, but as the following example shows, it probably is not. In Santa Paula, 'Olinda' Valencias on 'Carrizo' rootstock were converted to scions 'Allen' Eureka lemon, or 'Powell' late navel. In 1998 and 2000, the 'Olinda's were interplanted with either 'Allen' on 'Macrophylla' or late navel 'Powell' or 'Chislett' (on either 'Carrizo or 'C-35' rootstocks). The 'Olinda's were topworked in 2002 and 2003 to one of the new scions. In a few cases, 'Allen' was stump grafted, but most trees were scaffold grafted.

Several steps are required for topworking that will ensure success. These are listed below:

- Get a reputable person to do the work.
- Time of year is critical for grafting. Spring is best.
- Leave a nurse limb.
- Decide to stump or scaffold graft.
    - Stump grafting requires only 3 – 4 buds or sticks
    - Scaffold grafting requires 2 buds per scaffold. Consider winds since even one-year old unions are very tender.
- Sequence of events
    - Line up budwood
    - Remove top of tree and stack brush
    - Whitewash trunks
    - Paint cutoff surfaces
    - Insert grafts
    - Wrap grafts with plastic tape
    - Place white paper bag over grafts and tape in place

  Later
    - Keep after ants and snails
    - Shred brush
    - Remove bags when shoots start growing through them.
    - Bi-monthly, in first year, brush out water sprouts. Less often in the next 2 years

Much of this work can be contracted with the grafter, who usually assures some level of performance, something like 90% take. It is up to the grower to ensure that pests do not take out the grafts.

The costs of topworking are associated with the costs of the budwood (as much as $3 per tree), the act of grafting (depending on stump or scaffold, $8-10 per tree) and water sprout removal. Sprout removal is six times in year one, eight times in year two and only four times in year three. At a labor rate of $12 per hour, sprout removal costs $7.20 per tree.

A like for like comparison of topworking versus replanting based on 2002 data is shown below.

So in the case of both the lemon and navels it costs a bit more to topwork, but the results are earlier production. Here the topworked trees gain the economic advantage. For example, if cultural costs were $1000 per acre per year (20 by 20 ft. spacing) and, conservatively, two years are saved, the maintenance savings per tree would be $18. In the above study the time advantage appears even greater. Three-year old topworked lemons produce about the same as 6-year old replants. Two year old topworked navels have a significantly larger canopy than six-year old replant navels and appear to have about the same fruit set for the coming year.

	Replant		Topwork	
Lemons	Tree	$10.50	Graft	$8.00
	Planting	2.50	Sprout removal	7.20
	Total	$13.00		$15.20
Late Navels	Tree	$12.50	Royalty for buds	$2.25
	Planting	2.50	Graft	8.00
			Sprout removal	7.20
	Total	$15.00		$17.45

Chart 1. Susceptibility of Annual Broadleaf Weeds to Herbicides Registered in Citrus in California

By Kurt Hembree: Farm Advisor

	Pre-emergence													Post-emergence									
C = Controlled P = Partial control N = No control -- = No information	**BRD**	**BRO**	**DIU**	**EPT**	**ISO – NB**	**NAP**	**NOR**	**ORY**	**OXY – NB**	**PEN – NB**	**SIM**	**THI**	**TRI**	**CLE – NB**	**DIQ – NB**	**DSM – NB**	**FLU – NB**	**GLY**	**MSM – NB**	**OXY – NB**	**PAR**	**SET**	**SUL**
Annual Broadleaves																							
Annual morningglories	C	C	C	--	C	P	C	P	C	N	C	--	C	N	P	P	N	C	P	C	P	N	C
Cheeseweed	C	C	P	N	C	P	P	P	C	P	P	C	N	N	C	P	N	P	N	C	C	N	P
Chickweeds	C	C	P	C	C	C	P	C	P	C	C	C	C	N	C	C	N	C	C	N	C	N	C
Clovers	P	P	P	N	P	P	N	N	P	N	C	--	N	N	P	N	N	P	N	N	P	N	P
Cockleburs	C	C	C	N	--	P	C	N	P	N	C	--	N	N	C	P	N	C	P	C	C	N	C
Cudweeds	C	C	C	P	C	C	C	N	N	N	C	C	N	N	C	N	N	C	N	C	C	N	P
Fiddleneck	C	C	C	C	C	C	P	C	C	C	C	C	C	N	C	N	N	C	N	C	C	N	C
Filarees	C	C	C	P	C	C	P	P	C	N	C	C	P	N	C	N	N	P	N	C	P	N	C
Goosefoot, nettleleaf	C	C	C	C	C	C	P	C	C	C	C	C	C	N	C	N	N	C	N	C	C	N	C
Groundcherries	C	C	C	C	C	N	C	N	C	N	C	P	P	N	C	N	N	C	P	C	C	N	C
Groundsel, common	C	C	N	C	C	P	P	N	C	N	P	C	N	N	C	N	N	C	N	C	C	N	C
Hairy fleabane	C	C	P	C	C	N	P	N	P	N	C	P	N	N	P	N	N	C	N	P	P	N	C
Henbit	C	C	C	C	C	N	P	C	C	C	C	P	P	N	C	C	N	P	C	C	C	N	C
Horseweed	C	C	P	C	C	N	P	N	P	N	C	P	N	N	C	N	N	C	N	P	P	N	C
Knotweed, prostrate	C	C	C	P	C	C	P	C	P	C	C	C	C	N	P	N	N	P	N	N	P	N	P
Lambsquarters	C	C	C	C	C	C	P	C	C	C	C	C	C	N	C	N	N	C	N	C	P	N	C
London rocket	C	C	C	C	C	C	P	N	C	P	C	P	N	N	C	N	N	C	N	P	C	N	C
Mullein, turkey	P	P	N	N	C	P	P	N	P	N	N	C	P	N	P	N	N	P	N	N	P	N	P
Mustards	C	C	C	N	C	P	P	N	C	P	C	P	N	N	C	N	N	C	N	P	C	N	C
Nettles	C	C	C	C	C	P	C	P	C	N	C	C	N	N	P	N	N	N	N	C	C	N	N
Nightshades	C	C	C	P	C	N	C	N	C	N	C	P	N	N	C	N	N	C	N	C	C	N	C
Pigweeds	C	C	C	C	C	C	P	C	C	C	C	C	C	N	C	N	N	C	N	C	C	N	C
Prickly lettuce	C	C	C	C	C	C	P	N	C	N	C	C	N	N	C	N	N	C	N	P	P	N	C
Primrose, cutleaf evening	C	C	P	--	C	P	N	P	P	P	C	C	P	N	C	--	N	C	N	P	C	N	C
Puncturevine	C	C	P	N	C	P	C	P	P	P	P	P	P	N	C	P	N	C	P	P	C	N	C
Purslanes	C	C	C	C	C	C	C	C	C	C	C	C	C	N	C	N	N	C	N	P	C	N	C
Russian thistle	C	C	P	P	C	P	C	P	P	P	C	P	P	N	P	N	N	C	N	N	P	N	P
Shepherd's-purse	C	C	C	P	C	P	P	N	C	P	C	C	N	N	C	N	N	C	N	C	C	N	C
Sowthistles	C	P	C	C	C	C	P	N	C	N	C	C	N	N	C	N	N	C	N	C	C	N	C
Spotted spurge	P	P	N	N	C	C	C	P	C	P	P	P	P	N	C	N	N	C	N	N	C	N	C
Wild radish	C	C	C	N	C	P	P	N	C	N	C	C	N	N	C	N	N	C	N	P	C	N	C
Willowherb, panicle	C	C	N	--	P	N	P	P	C	--	N	--	--	N	P	N	N	P	--	N	P	N	P

NB = Non-bearing orchards

BRD = bromacil + diuron (Krovar)
BRO = bromacil (Hyvar X)
DIU = diuron (Karmex, Direx)
EPT = EPTC (Eptam)
ISO = isoxaben (Gallery T&V)
NAP = napropamide (Devrinol)
NOR = norflurazon (Solicam)
ORY = oryzalin (Surflan)
OXY = oxyfluorfen (Goal)
PEN = pendimethalin (Prowl)
SIM = simazine (Princep Caliber 90, etc.)
THI = thiazopyr (Visor)
TRI = trifluralin (Treflan, etc.)
CLE = clethodim (Prism)
DIQ = diquat (Reglone)
DSM = DSMA DSMA, etc.)
FLU = fluazifop-p (Fusilade DX)
GLY = glyphosate (Roundup, etc.)
MSM = MSMA (MSMA, etc.)
PAR = paraquat (Gramoxone Max)
SET = sethoxydim (Poast)
SUL = sulfosate (Touchdown 5)

This chart is not a recommendation for the use of herbicides. Please refer to the appropriate label for application recommendations. Proper weed identification, timing, and accurate application are important for effective control. The information in this chart is tentative and may change as warranted. Always follow the label carefully when using herbicides. Kurt J. Hembree, Farm Advisor, Fresno County. January 2004.

Chart 2. Susceptibility of Annual Grass and Perennial Weeds to Herbicides Registered in Citrus in California

C = Controlled P = Partial control N = No control -- = No information	Pre-emergence													Post-emergence									
	BRD	BRO	DIU	EPT	ISO – NB	NAP	NOR	ORY	OXY – NB	PEN – NB	SIM	THI	TRI	CLE – NB	DIQ – NB	DSM – NB	FLU – NB	GLY	MSM – NB	OXY – NB	PAR	SET	SUL
Annual grasses																							
Annual bluegrass	C	C	C	C	N	C	C	C	P	C	C	C	C	C	P	N	N	C	N	N	C	N	C
Barnyardgrass	C	C	C	C	N	C	P	C	P	C	P	C	C	C	P	P	C	C	P	P	P	C	C
Bromegrasses	C	C	C	C	N	C	C	C	P	C	--	C	C	P	--	N	P	C	--	N	C	P	C
Canarygrass	C	C	C	C	N	C	C	C	P	C	P	C	C	C	P	N	C	C	N	N	C	C	C
Crabgrass, large	C	C	C	C	N	C	P	C	N	C	N	C	C	C	C	C	C	C	C	N	C	C	C
Fescues	--	--	C	C	N	C	C	C	N	C	P	P	C	P	C	N	P	C	--	N	C	P	C
Foxtails	C	C	C	C	N	C	P	C	N	C	C	C	C	C	P	--	C	C	--	N	P	C	C
Junglerice	C	C	C	C	N	C	P	C	P	C	P	C	C	C	P	P	C	C	P	P	P	C	C
Lovegrass	C	C	C	C	N	C	P	C	C	C	P	P	C	C	P	--	C	C	--	N	C	C	C
Ryegrass, Italian	C	C	C	C	N	C	C	C	N	C	P	C	C	C	P	N	C	C	N	N	C	C	C
Sandbur	C	C	C	C	N	C	C	C	N	C	C	C	C	C	P	N	C	C	C	N	P	C	C
Sprangletops	C	C	P	C	N	C	P	P	N	P	N	C	C	C	N	N	C	C	N	P	P	C	C
Wild barley	C	C	C	C	N	C	C	C	P	C	P	C	C	C	P	N	C	C	N	N	C	C	C
Wild oats	C	C	P	C	N	C	C	P	P	P	C	P	P	P	P	N	C	C	N	N	C	C	C
Witchgrass	C	C	C	C	N	C	P	C	P	C	P	P	C	C	P	N	P	C	N	N	C	P	C
Perennials (seedling)																							
Bermudagrass	C	C	C	C	N	C	C	C	P	C	P	C	C	C	P	N	C	C	N	N	C	C	C
Dallisgrass	C	C	C	C	N	C	C	C	P	C	C	C	C	C	P	C	C	C	C	N	C	C	C
Johnsongrass	C	C	C	C	N	C	C	C	P	C	C	C	C	C	P	C	C	C	C	N	C	C	C
Field bindweed	C	C	P	N	C	N	P	P	P	P	P	P	P	N	P	N	N	C	N	N	C	N	C
Perennials (established)																							
Bermudagrass	P	P	N	N	N	N	P	N	P	N	N	N	N	C	N	N	C	C	N	N	N	C	C
Dallisgrass	P	P	N	N	N	N	P	N	P	N	N	N	N	C	N	P	C	C	C	N	N	C	C
Johnsongrass	P	P	N	N	N	N	C	N	P	P	N	P	P	C	N	N	C	C	N	N	N	C	C
Field bindweed	P	P	N	N	N	N	N	N	N	P	N	P	P	N	P	N	N	P	N	N	P	N	P
Nutsedge, purple	C	C	N	P	N	N	P	N	N	N	N	P	N	N	P	P	N	C	P	N	P	N	C
Nutsedge, yellow	C	C	N	P	N	N	P	N	N	N	N	C	N	N	P	P	N	C	C	N	C	N	C

NB = Non-bearing orchards
Note: repeated applications may be required for perennial weeds

BRD = bromacil + diuron (Krovar)
BRO = bromacil (Hyvar X)
DIU = diuron (Karmex, Direx)
EPT = EPTC (Eptam)
ISO = isoxaben (Gallery T&V)
NAP = napropamide (Devrinol)
NOR = norflurazon (Solicam)
ORY = oryzalin (Surflan)
OXY = oxyfluorfen (Goal)
PEN = pendimethalin (Prowl)
SIM = simazine (Princep Caliber 90, etc.)
THI = thiazopyr (Visor)
TRI = trifluralin (Treflan, etc.)
CLE = clethodim (Prism)
DIQ = diquat (Reglone)
DSM = DSMA DSMA, etc.)
FLU = fluazifop-p (Fusilade DX)
GLY = glyphosate (Roundup, etc.)
MSM = MSMA (MSMA, etc.)
PAR = paraquat (Gramoxone Max)
SET = sethoxydim (Poast)
SUL = sulfosate (Touchdown 5)

This chart is not a recommendation for the use of herbicides. Please refer to the appropriate label for application recommendations. Proper weed identification, timing, and accurate application are important for effective control. The information in this chart is tentative and may change as warranted. Always follow the label carefully when using herbicides. Kurt J. Hembree, Farm Advisor, Fresno County. January 2004.

Table 1. Performance of Pre-emergence Herbicides in Citrus in California

Herbicide	Conditions favoring effective weed control and crop safety
bromacil (Hyvar-X)	Used at 3.2-6.4 lb a.i./acre. For use in orchards >4 years old. Applied as a single or split application in winter and spring. Rainfall or irrigation occurs within 21 days of treatment. ***Do not use in Kern County***.
bromacil + diuron (Krovar)	Used at 3.2-4.8 lb a.i./acre. For use in orchards >4 years old. Applied as a single or split application in winter and spring. Rainfall or irrigation occurs within 21 days of treatment. Can cause injury to citrus and other trees if runoff water contacts their roots. ***Do not use in Kern, Imperial, or Coachella valleys***.
diuron (Karmex, Direx)	Used at 2.4-3.2 lb a.i./acre. For use in orchards >1 year old. Use lower rates for lighter soils, especially under drip or other low-volume irrigation. Works well under furrow irrigation. It can be mixed with simazine for broader control. ***Do not use in Imperial or Coachella valleys***.
EPTC (Eptam)	Used at 2.1-3.0 lb a.i./acre. For use in bearing and non-bearing orchards. Incorporated 2" deep with rotary hoe or water-run on level soils. Provides short-term residual control (4-6 weeks). 15 day PHI.
isoxaben (Gallery T&V)	Used at 0.66-1.33 lb a.i./acre. ***For use in non-bearing orchards only***. Application made after trees have completely settled into the soil. Rainfall or irrigation of at least 0.5" needed within 21 days of treatment. Used only where broadleaf weeds are expected; does not control grasses or nutsedge.
napropamide (Devrinol 50 DF)	Used at 4.0 lb a.i./acre. For use in bearing and non-bearing orchards. Must be incorporated by rainfall or sprinkler irrigation within 7 days of treatment. Residual control is reduced under frequent, low-volume drip or micro-sprinkler irrigation. It should be combined with post-emergence herbicides if weeds are emerged. Soil surface is clear of leaves and other debris. Residual period is 4-10 months.
norflurazon (Solicam)	Used at 1.0-4.0 lb a.i./acre. For use in bearing and non-bearing orchards. Use lower rates on coarse soils under low-volume irrigation. Rainfall or irrigation is needed within 28 days of treatment. It can help to reduce low to moderate levels of nutsedge. It has an 18 month plant-back period; follow the label regarding planting restrictions. 30 day PHI.
oryzalin (Surflan, Oryzalin, etc.)	Used at 2.0-6.0 lb a.i./acre. For use in bearing and non-bearing orchards. Apply to soil free of leaves and other debris. Rainfall or irrigation of 0.25-2" needed within 21 days of treatment. Mixed with other herbicides for broader weed control. A post-emergence herbicide should be added if weeds are emerged. Applied at 6 lb a.i. for longer residual control. Residual period is 4-10 months.
oxyfluorfen (Goal 2XL, etc.)	Used at 1.2-2.0 lb a.i./acre. ***For use in non-bearing orchards only***. Applied in 20-60 gal water/acre. Rainfall or irrigation of at leas 0.75" needed within 21-28 days of treatment. Do not disturb the soil following treatment, or poor weed control will result. It is often combined with oryzalin for broad-spectrum weed control. Refer to the label for use period, cut-off dates, and other restrictions. Residual period 4-10 months. Used at 0.5-1 lb a.i./acre for burn-down.
pendimethalin (Prowl 3.3, etc.)	Used at 2.0-4.0 lb a.i./acre. ***For use in non-bearing orchards only***. Applied in 20-40 gal water/acre to soil surface. Rainfall, irrigation, or mechanical incorporation needed within 4 days of treatment. Directed to trees, avoiding contact with foliage.
simazine (Princep, Caliber 90, etc.)	Used at 2.0-4.0 lb a.i./acre. For use in orchards >1 year old. Rainfall or flood irrigation occurs within 28 days of treatment. Do not use on sandy soils. Adjust rate to soil type. Do not use on fields prone to runoff or in PMZ zones, unless approved. Mixed with diuron at 1-2 lb a.i./acre each for broad-spectrum control. ***Do not use in Imperial, Coachella, or Palo Verde valleys***.
thiazopyr (Visor)	Used at 0.5-1.0 lb a.i./acre. For use in bearing and non-bearing orchards. Applied in 20-40 gal water/acre. Applied at 0.5 lb a.i. in the fall and again in the late-winter for nutsedge control. Rainfall is needed within 21 days of treatment. Increased rainfall improves nutsedge control. Tank-mixed with Goal (in non-bearing) for broader residual control. Residual period is 5-8 months. 90 day PHI.
trifluralin (Treflan, etc.)	Used at 0.5-1.0 lb a.i./acre. It can be applied before planting and disk incorporated 2-4" deep. Useful for helping eradicate Johnsongrass prior to planting. Granular formulation can be used after planting and incorporated immediately after planting.

Numerous factors influence the performance of herbicides. The observations and comments in this table assume proper weed identification and accurate application and timing of treatments. Consult Charts 1 and 2 and the proper herbicide labels for the effectiveness of the registered herbicides to control your specific weeds. This table is not intended to be a recommendation for the use of herbicides. Always follow the label carefully when using herbicides. Kurt J. Hembree, Farm Advisor, Fresno County. January 2004.

Table 2. Performance of Post-emergence Herbicides in Citrus in California

Herbicide	Conditions favoring effective weed control and crop safety
clethodim (Prism)	Used at 0.09-0.25 lb a.i./acre. ***For use in non-bearing orchards only***. A crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v) is added. Applied in 20-40 gal water/acre with thorough weed coverage. Gives selective control of annual grasses (except bromes and fescues) that are actively growing, before tillering, and not stressed. Annual bluegrass is controlled if treated early in its growth. Repeat applications are required on perennials when their growth is according to label.
diquat dibromide (Reglone)	Used at 0.375-0.5 lb a.i./acre. ***For use in non-bearing orchards only***. A non-ionic surfactant is added at 0.25% v/v. Applied in 20-60 gal water/acre with thorough weed coverage. Weeds are less than 4" tall. Control is improved during warm, dry weather.
dsma (DSMA, etc.)	Used at 2.4-4.8 lb a.i./acre. For use in bearing and non-bearing orchards. A non-ionic surfactant is added at 0.25% v/v. Applied in 20-60 gal water/acre with thorough weed coverage. Gives best control when applied during warm, dry weather. Suppresses nutsedge.
fluazifop-p-butyl (Fusilade DX)	Used at 0.25-0.375 lb a.i./acre. ***For use in non-bearing orchards only***. A crop oil concentrate (1% v/v) or a non-ionic surfactant (0.25% v/v) is added. Applied in 20-40 gal water/acre with thorough weed coverage. Gives selective control of annual grasses (except annual bluegrass, bromes, or fescues) that are actively growing, before tillering, and not stressed. Repeat treatments are required on perennials when their growth is according to label.
glyphosate (Roundup UltraMax, etc.)	Used at 0.5-4.0 lb a.i./acre. For use in bearing and non-bearing orchards. Applied by ground with low-pressure, flat fan nozzles, controlled droplet applicator, or smart sprayer. Add AMS at 5-10 lb/100 gal water to improve control. For annual weeds, use 1.0 lb a.i. in 3-40 gal water/acre. Apply to young, growing annuals or perennials when they are flowering. Some perennials require highest label rate. Hairy fleabane and horseweed can be controlled it treated in the seedling stage. Avoid drift onto green wood or foliage of trees. Weeds should not be cultivated for 7-14 days after treatment. Can be combined with low rates of oxyfluorfen (non-bearing) for broader weed control, as well as combined with pre-emergence herbicides.
msma (MSMA, etc)	Used at 2.0 lb a.i./acre. ***For use in non-bearing orchards only***. Trees are >1 year old. Applied on yellow nutsedge with fewer than 5 leaves in 60 gal water/acre. Multiple applications may be needed. Air temperature is around 85ºF for best activity.
oxyfluorfen (Goal 2XL, etc.)	Used at 0.5-1.0 lb a.i./acre. ***For use in non-bearing orchards only***. Applied to weeds at the 4-leaf stage or sooner. Combined with glyphosate or other post-emergence herbicides to control specific weeds.
paraquat (Gramoxone Max, etc.)	Used at 0.3-0.9 lb a.i./acre. For use in bearing and non-bearing orchards. A non-ionic surfactant is added at 0.5% v/v. Applied in 20-60 gal water/acre with thorough weed coverage. Weeds are less than 4" tall. Repeat applications needed as new growth occurs. Do not allow drift to contact fruit, or injury will occur. A restricted herbicide, requiring a permit from the county agricultural commissioner for purchase and use.
sethoxydim (Poast, etc.)	Used at 0.28-0.47 lb a.i./acre. For use in bearing and non-bearing orchards. A crop oil concentrate is added at 1% v/v. Applied in 20-40 gal water/acre with thorough weed coverage. Gives selective control of annual grasses (except annual bluegrass, bromes, or fescues) that are actively growing, before tillering, and not stressed. Repeat treatments are required on perennials when their growth is according to label.
sulfosate (Touchdown 5)	Used at 1.0-4.0 lb a.i./acre. For use in bearing and non-bearing orchards. A non-ionic surfactant can be added at 0.25% v/v. Applied in 10-30 gal water/acre. Use low-pressure, flat fan nozzles, not flood jets. For perennials, use higher label rates. Hairy fleabane and horseweed can be controlled it treated in the seedling stage. Avoid drift onto green wood or foliage of trees or injury will result.

Numerous factors influence the performance of herbicides. The observations and comments in this table assume proper weed identification and accurate application and timing of treatments. Consult Charts 1 and 2 and the proper herbicide labels for the effectiveness of the registered herbicides to control your specific weeds. This table is not intended to be a recommendation for the use of herbicides. Always follow the label carefully when using herbicides. Kurt J. Hembree, Farm Advisor, Fresno County. January 2004.

FARM ADVISORS:

Gary Bender – *Subtropical Horticulture, San Diego*
Phone: (858) 694-2856
email to: gsbender@ucdavis.edu
website: http://cesandiego.ucdavis.edu

Mary Bianchi – *Horticulture/Water Management, San Luis Obispo*
Phone: (805) 781-5949
email to: mlbianchi@ucdavis.edu
website: http://cesanluisobispo.ucdavis.edu

Ben Faber – *Subtropical Horticulture, Ventura/Santa Barbara*
Phone: (805) 645-1462
email to: bafaber@ucdavis.edu
website: http://cesantabarbara.ucdavis.edu

Mark Freeman – *Citrus and Nut Crops, Fresno/Madera*
Phone: (559) 456-7265 email to: mwfreeman@ucdavis.edu
website: http://cefresno.ucdavis.edu/newsletter.htm

Craig Kallsen - *Subtropical Horticulture and Pistachios, Kern*
Phone: (661) 868-6221
email to: cekallsen@ucdavis.edu
website: http://cekern.ucdavis.edu

Peggy Mauk – *Subtropical Horticulture, Riverside/San Bernardino*
Phone: (909) 683-6491 Ext. 221 email to: pamauk@ucdavis.edu
website: http://cesanbernardino.ucdavis.edu

Neil O'Connell – *Citrus/Avocado, Tulare*
Phone: (559) 685-3309 ext 212 email to: nvoconnell@ucdavis.edu
website: http://cetulare.ucdavis.edu

Eta Takele – *Area Ag Economics Advisor*
Phone: (909) 683-6491 ext. 243 email to:takele@ucrac1.ucr.edu

Neil O'Connell
Citrus Farm Advisor

UC CE University of California Cooperative Extension