

Fox Canyon Groundwater Management Agency

Grower Meeting -- September 8, 2011



Irrigation Training and Research Center
California Polytechnic State University, San Luis Obispo (Cal Poly)

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Today

- Discuss some background on why the IE program was modified
- Introduction to the new Irrigation Allowance Program
- Some issues that are being investigated
- Future modifications likely with Grower Input

2010 – ITRC Investigated the IE Program for FCGMA

- **Task 2.1** – Analysis and annual plant required water values for crops in the FCGMA
- **Task 2.2** – Evaluation of strengths and weaknesses of the existing FCGMA IE program and specific suggestions for improvement

Old FCGMA IE Program

- **Strengths**
 - Attempts to account for regional and year to year differences in allowable water computations
 - Simple methodology
- **Weaknesses**
 - Too simple. Based on 3 crop categories while there are dozens of different crop types grown in FCGMA
 - Historically weather data utilized has had quality issues

Old Allowed Water Table

Fox Canyon Groundwater Management Agency
2009 Eto, Effective Rainfall & Allowed Water for Various Crops
(California State Water Resources)

Station	Total Eto	Actual Ratio	Total Effective Ratio				Total Allowed Water (inches or mm/acre)						
			Ground	Surface	Change	Subtotal	Almonds	Other Crops	Change	Subtotal			
Midrange Total	42.53	0.81	0.00	0.04	0.00	0.04	0.00	0.00	0.04	41.44	41.44	41.44	41.44
Lower Total	72.24	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62.88	62.88	62.88	62.88
Upper Total	20.84	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.64	14.64	14.64	14.64
Allowed Total													
Almonds	10.50	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.50	10.50	10.50	10.50
Other Crops	10.34	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.34	10.34	10.34	10.34
Allowed Total													

• **Not the correct definition for Irrigation Efficiency**

Irrigation Efficiency

The technical definition of IE¹ is:

$$IE = \frac{(Vol. of Irrigation Water Beneficially Used)}{(Vol. of irrigation water applied - Change in RZ water storage)} \times 100\%$$

This equation limits IE to less than or equal to 100% - irrigation water beneficially used cannot be greater than irrigation water applied

¹Burt, C. M., A. J. Clummins, T. S. Strickoff, K. H. Solomon, R. D. Blesner, L. A. Hardy, T. A. Howell and D. E. Goodenow. (1997). "Irrigation Performance Measures: Efficiency and Uniformity." Journal of Irrigation and Drainage Engineering, 123(6): 423-442.

General Recommendations

- **Abandon FCGMA IE**
 - Improper computation of IE and other issues
- **Replace with new Irrigation Allowance Program – More Accurate Assessment of ET**
 - Increased number of crop categories (**24+**)
 - Multiple cropping (double and triple cropping)
 - Perennial crop age (canopy coverage) considered
 - Utilize 3 ET_o Zones



Irrigation Allowance Index Formula

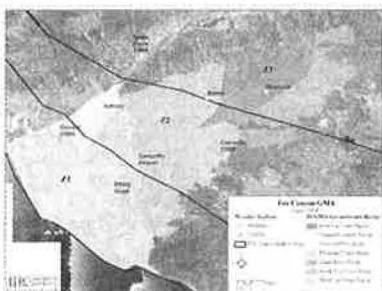
- Simple Ratio

$$\text{Irrigation Allowance Index} = \frac{\text{Applied Water}}{\text{Irrigation Allowance}}$$

Values less than or equal to 1 are ideal



Recommended FCGMA ET_o Zones



- Zone 1 (Z1) – Oxnard CIMIS and FCGMA Etting Road Station
- Zone 2 (Z2) – Camarillo CIMIS and FCGMA Camarillo Airport Station
- Zone 3 (Z3) – Santa Paula CIMIS and FCGMA Moorpark Station

Use CIMIS as primary and FCGMA station as backup



Irrigation Allowance Includes

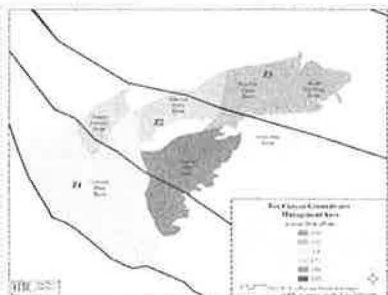
- Evapotranspiration of Irrigation Water
 - Includes Santa Ana Winds
- Irrigation water for salinity management
- Water to overcome a reasonable irrigation system distribution non-uniformity (DU = 0.8 is reasonable in FCGMA)
- Irrigation water for frost protection

$$\text{Irrigation Allowance} = \frac{\text{Growing Period } ET_w}{((DU + \text{Localized Deep Perc. on Drip}) \times (1 - LR))}$$



Salinity Management

- Assumed average basin wide EC_w = 1.8 dS/m
- Value is high but common in some areas



Salinity Management

- Research underway on strawberries and already conducted on tomatoes show drip influences salinity management
- Utilized the most recent research to estimate water needed for salinity management
- May need to be fine tuned as additional information becomes available



DRAFT Irrigation Allowance

Crop	Oxnard (23)			Camarillo (22)			Santa Paula (22)		
	Typical Total (inches)	Dry Total (inches)	Wet Total (inches)	Typical Total (inches)	Dry Total (inches)	Wet Total (inches)	Typical Total (inches)	Dry Total (inches)	Wet Total (inches)
Avocado - 20% Cover	22	25	21	25	28	23	28	30	25
Avocado - 50% Cover	32	35	30	37	43	33	40	44	37
Avocado - 70% Cover	44	49	42	50	56	49	54	59	53
Blueberries - 20% Cover	22	25	21	25	28	23	28	30	25
Blueberries - 50% Cover	32	35	30	37	43	33	40	44	37
Blueberries - 70% Cover	44	49	42	49	57	47	54	57	52
Celery - Fall	18	18	16	19	20	18	20	22	19
Celery - Spring	19	21	19	21	24	20	26	28	22
Citrus - 20% Cover	19	20	17	20	21	18	21	22	19
Citrus - 50% Cover	31	32	28	33	36	32	38	40	35
Citrus - 70% Cover	41	43	38	47	48	43	51	53	47
Lima Beans	12	13	12	14	15	14	15	16	15
Misc. Veg Greenhouse - Fall	10	10	10	11	11	11	12	12	12
Misc. Veg Greenhouse - Spr	10	10	10	10	10	10	10	10	10
Misc. Veg Greenhouse - Summer	10	10	10	10	10	10	10	10	10
Misc. Veg Single Crop - Fall	11	12	9	12	14	11	13	15	12
Misc. Veg Single Crop - Spring	19	20	18	21	24	20	23	26	22
Misc. Veg Single Crop - Summer	19	20	18	21	24	20	23	26	22
Nursery - Container	51	54	48	58	62	56	64	67	61
Nursery - Greenhouse	54	56	51	62	63	59	67	69	64
Peppercorn - Harvest	52	54	50	58	61	57	63	67	63
Sod	48	51	47	54	57	53	59	63	58
Strawberries - Main Season	17	18	16	19	20	18	20	22	19
Strawberries - Summer	15	16	14	17	17	16	18	19	18
Tomatoes - Peppercorn	17	17	16	18	19	18	19	20	19

*Add 0.5 inches per front event.



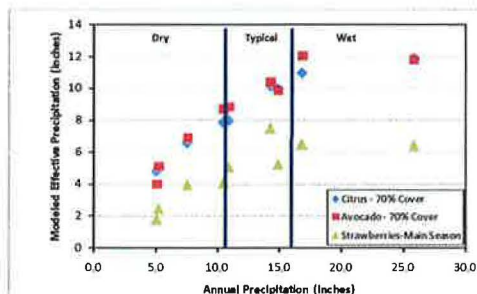
New Allowance Program

- Single value for each ETo Zone dependent on rainfall during the year – From CIMIS
- 3 year types – Wet, Dry, and Typical
 - Determined through examining modeled effective precipitation vs. total precipitation from 2000-2009. General trends existed allowing grouping into the 3 categories.

Year Type	Precipitation Range (inches)
Typical	11 – 17
Dry	<11
Wet	>17



Year Type Selection



Continue to Utilize Weather Stations

- 3 ETo Zones each with 2 weather stations.
- CIMIS station is primary
- FCGMA weather stations are backup
- Collect ETo as a check
- Collect precipitation data for year type selection
- County precipitation gauges can be used as a check as well.



Improving Weather Station Site Conditions

- All weather stations should look similar to:



Camarillo
CIMIS



Santa Paula
CIMIS

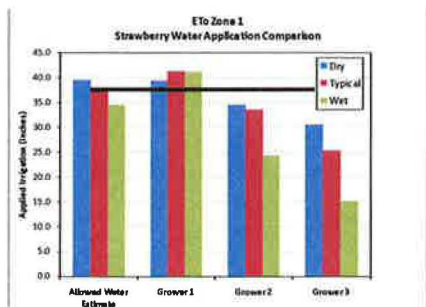


Comparison of Allowed Water and Irrigation Allowance

Crop	Oxnard (23)		Camarillo (22)		Santa Paula (22)	
	ITRC Allowance (in)	FCGMA Road Allowed (in)	ITRC Allowance (in)	FCGMA Camarillo Allowed (in)	ITRC Allowance (in)	FCGMA Moorpark Allowed (in)
Avocado - 20% Cover	22	47	25	45	28	54
Avocado - 50% Cover	32	47	37	45	40	54
Avocado - 70% Cover	44	47	50	48	54	54
Blueberries - 20% Cover	22	52	30	50	30	61
Blueberries - 50% Cover	32	52	42	50	34	61
Celery - Fall	18	52	36	50	38	61
Celery - Spring	19	52	36	50	38	61
Citrus - 20% Cover	19	47	20	44	26	54
Citrus - 50% Cover	31	47	30	45	38	54
Citrus - 70% Cover	41	47	47	45	51	54
Lima Beans	12	47	14	45	15	54
Misc. Veg Greenhouse - Fall	10	51	11	48	12	60
Misc. Veg Greenhouse - Spr	10	51	10	48	10	60
Misc. Veg Greenhouse - Summer	10	51	10	48	10	60
Misc. Veg Single Crop - Fall	11	52	12	48	13	60
Misc. Veg Single Crop - Spring	19	52	21	48	23	60
Misc. Veg Single Crop - Summer	19	52	21	48	23	60
Nursery - Container	51	51	60	48	66	60
Nursery - Greenhouse	54	52	63	50	69	61
Peppercorn - Harvest	52	52	63	50	69	61
Sod	48	51	54	50	59	61
Strawberries - Main Season	17	52	19	50	19	61
Strawberries - Summer	15	52	17	50	18	61
Tomatoes - Peppercorn	17	51	18	48	19	60



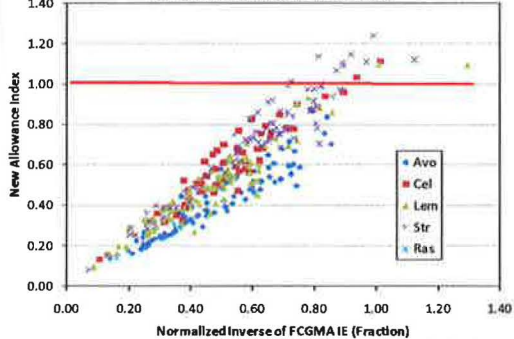
Allowance Values Compared to Several Strawberry Grower Applied Water Values



Important Improvements with Proposed Irrigation Allowance Program

- For some crops the New Irrigation Allowance does not differ much from the original FCGMA values
- Key differences –
 - Canopy coverage (orchard age and thinning considerations)
 - Differentiating single, double and triple cropping

Comparison of New Allowance Values and Historical IE Values for 2007 (Dry), 2009 (Typical), and 2010 (Wet)



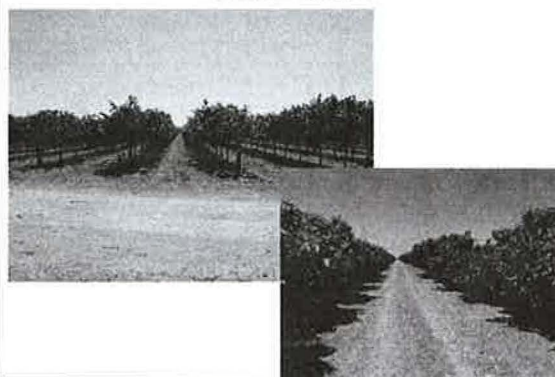
Difficulties

- Vegetated vs. Total Farm Acreage
- Canopy coverage/orchard age
 - Requires grower estimates
 - To confirm estimates it is recommended that growers submit an aerial photo of farm from Google/Yahoo/Bing maps
 - Aerial should be no more than 2-3 years old

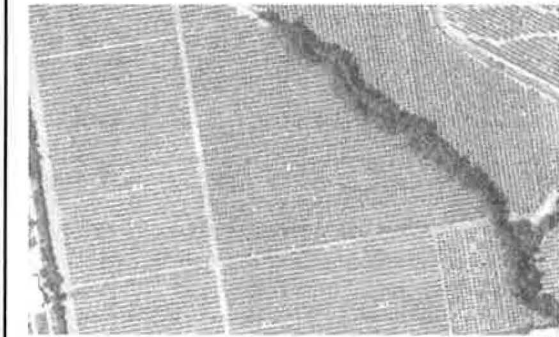
Canopy Coverage ~20% Cover



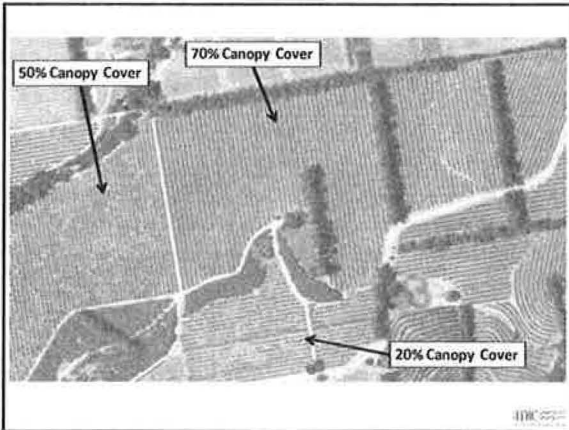
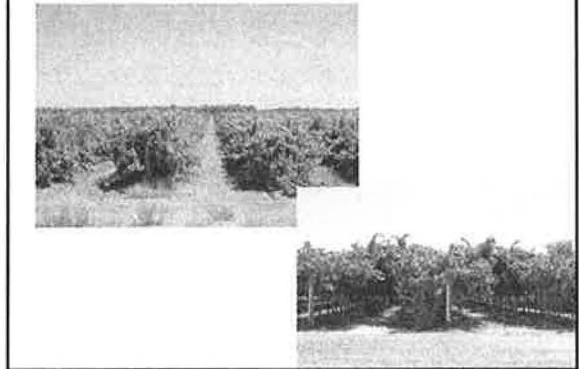
~50% Cover



~50% Cover



~70% Cover or More



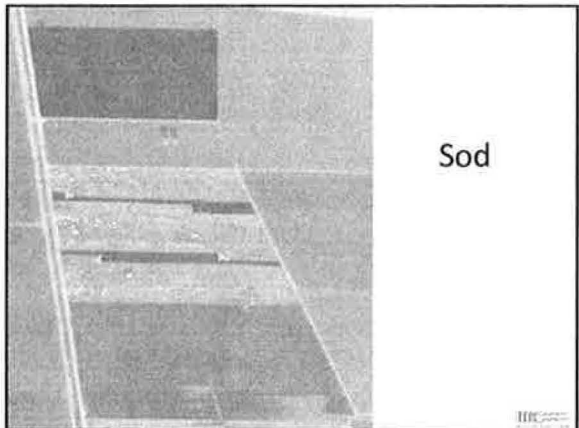
Difficulties (cont.)

- Nursery and Sod Farms
 - Irrigation Allowance values are for full canopy or vegetative cover
 - However, at any time only 50-90% (or less) of the area may be cropped.
 - Need growers to provide estimates of the average vegetative area on an annual basis.
 - May need further refinement with additional studies.

Nursery



Sod



Greenhouses and Tunnels

- Used information from grower survey and published data to estimate growing period ETiw in greenhouses and tunnels
- Best available information:
 - However, many different methods of greenhouse operation.
 - Should be refined with more detailed evaluation of greenhouses in FCGMA (outside of the scope of this evaluation)



Example – 3 Strawberry Growers

- Crop – Strawberries
- Zone - 1
- Rainfall year = typical

	Grower 1 Inches	Grower 2 Inches	Grower 3 Inches
Applied Water	41.3	33.6	25.3
Allowed Water Estimate	37	37	37
Allowance Index	1.12	0.91	0.68

• Example Calculation - Irrigation Allowance Index = 41.3 in/37in = 1.12



Current DRAFT Irrigation Allowance

Crop	Climate [ET]			Climate [ET]			Climate [ET]		
	Typical Total Inches	Typical Total Inches	Typical Total Inches	Typical Total Inches	Typical Total Inches	Typical Total Inches	Typical Total Inches	Typical Total Inches	
Asparagus - 20% Cover	72	75	75	75	75	75	75	75	
Asparagus - 50% Cover	72	75	75	75	75	75	75	75	
Asparagus - 75% Cover	64	69	62	50	54	48	54	63	
Blueberries - 20% Cover	72	72	72	25	28	24	28	30	
Blueberries - 50% Cover	72	72	72	25	28	24	28	30	
Blueberries - 75% Cover	64	66	62	48	52	47	54	57	
Celery - Fall	38	38	38	39	20	14	20	22	
Celery - Spring	30	31	38	33	34	20	35	26	
Celery - 20% Cover	30	25	27	26	29	24	28	33	
Celery - 50% Cover	31	32	38	35	36	22	36	40	
Celery - 75% Cover	43	43	38	47	48	43	51	52	
Corn Sweet	12	13	12	14	15	14	15	15	
Mini. Veg Greenhouse - Fall	10	10	10	11	11	11	13	13	
Mini. Veg Greenhouse - Spring	15	15	15	16	16	16	18	18	
Mini. Veg Greenhouse - Summer	15	15	15	17	17	17	18	18	
Mini. Veg High Crop - Fall	11	12	9	12	14	11	12	12	
Mini. Veg High Crop - Spring	10	10	18	21	22	20	23	25	
Mini. Veg High Crop - Summer	24	25	23	27	28	26	29	30	
Miscellaneous - Veg House	11	14	10	12	12	12	14	14	
Miscellaneous - Greenhouse	14	16	12	15	15	15	17	17	
Asparagus - Fallow	12	14	10	12	12	12	14	14	
Asparagus - Soil	48	51	47	54	57	53	60	63	
Strawberries - 20% Cover	37	40	35	41	43	38	44	47	
Strawberries - 50% Cover	37	37	37	37	37	37	37	37	
Strawberries - 75% Cover	27	27	26	31	31	30	34	34	

*add 0.5 inches per frost event.



Summary

- The proposed Irrigation Allowance Program provides significant enhancements with minimal increase in complexity
- Different than the original FCGMA Allowed Water which had no fundamental basis other than ET_o
- The Irrigation Allowance values include ET of irrigation water, water for salinity management, and distribution uniformity
- The values are not "FINAL". We will be examining them for the first year of the program and updating where necessary.



Thank You
Questions??

