

Crop Coefficients for Estimating Small Grain Water Use, 2002

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Summary

Crop coefficients are used to estimate water use from reference evapotranspiration values provided by weather stations. Two varieties of barley and durum were planted at the Maricopa Agricultural Center in late November and early January. Water use was estimated from neutron probe readings and crop coefficients were calculated by dividing water use by reference evapotranspiration. The crop coefficients calculated in this study peaked close to 1.2, similar to published values, except for the short season barley cultivar Barcott which had much lower values than the other cultivars.

Introduction

Crop coefficients are used to calculate water use from weather data. The crop coefficient increases as the crop develops, reaches a peak, and then decreases as the crop senesces. Crop coefficients are most accurate if locally developed using current cropping practices. Crop coefficients have not been developed for Arizona, and we currently rely on values from California or values estimated indirectly from water use work done on outdated varieties by the Water Conservation Research Laboratory in Phoenix in the 1950's and 1960's. We intend to use the crop coefficients developed in Arizona to provide water use estimates for the Small Grain Advisory and for AZSCHED, irrigation scheduling software for Arizona. The purpose of this study is to develop crop coefficients for wheat and barley in Arizona.

Procedures

Two durum varieties (Kronos and WPB 881) and two barley varieties (Barcott and Baretta) were planted on November 29, 2001 at the Maricopa Agricultural Center. The plots were 42 ft by 40 ft in size and replicated twice in a randomized complete block design. Preplant fertilizer included 48 lbs N/acre and 60 lbs P₂O₅/acre as 16-20-0. Irrigation was applied at about 50% depletion of plant available water and 248 pounds of N were applied per acre (Table 1). Water use was estimated in 1 ft depth increments to 4 ft from weekly neutron probe readings. Crop coefficients were calculated by dividing water use by reference evapotranspiration (ET_o, original AZMET calculation method) from AZMET. Grain yields and growth stages were from an adjacent variety trial.

Results and Discussion

The growing season was dry with above average maximum temperature and below average minimum temperature (Table 2). The period from December to May was the second driest out of 16 years for Maricopa. The average monthly maximum temperature was above average particularly in February and April. The average monthly minimum temperature was below average in February and March, and these low temperatures slowed crop development.

Published values of crop coefficients for barley and wheat peak around 1.2, and the values obtained this year peak

approach 1.2 (Table 5). The crop coefficients were lower for the short season cultivar Barcott.

Acknowledgements

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Table 1. Cultural practices for the small grains planted on November 29, 2001.

Cultural practice	November 26, 2002 planting
Field	106
Border	6 of 9 (from south)
Previous crop	Sudangrass
Preplant soil NO ₃ -N	6.5 ppm
Preplant soil P	3.2 ppm
Row spacing	7 inches
Barley seeding rate	80 lbs/acre
Durum seeding rate	100 lbs/acre
Irrigation and fertilization	11/29 + 48 lbs N/a and 60 lbs P ₂ O ₅ /a
	01/25 + 50 lbs N/a
	02/22 + 50 lbs N/a
	03/14 + 50 lbs N/a
	03/28 + 50 lbs N/a
	04/12
	04/27
Total N applied	248 lbs N/a

Table 2. Climatic data for Maricopa during the 2002 growing season compared to the long-term average. The rankings of the months in the 16 years of data are from low to high. The climate data was obtained from AZMET.

Climate variable	Unit	Year(s)	Dec	Jan	Feb	Mar	Apr	May	Dec-May
Max Temp.	Rank of 16	2002	4	12	15	9	13	11	13
	°F	2002	63	67	74	77	88	95	77
	°F	1987-2002	65	66	70	76	85	94	76
Min Temp.	Rank of 16	2002	6	7	1	1	16	7	4
	°F	2002	33	34	35	40	54	58	42
	°F	1987-2002	35	36	39	44	51	59	44
Ppt.	Rank of 16	2002	10	3	1	1	1	1	2
	inches	2002	0.67	0.04	0.00	0.00	0.00	0	0.71
	inches	1987-2002	0.68	0.66	0.78	0.81	0.28	0.16	3.33

Table 3. Heading, flowering and physiological maturity for the varieties.

Planting date	Stage	Date			
		Barcott	Baretta	Kronos	Westbred 881
Nov 29	Heading	3/07	3/20	3/25	3/26
	Flowering	3/07	3/21	3/29	3/30
	Maturity	4/12	5/02	5/06	5/06

Table 4. Grain yields for the varieties.

Planting date	Grain Yield			
	Barcott	Baretta	Kronos	Westbred 881
	----- lbs/acre -----			
Nov 29	5389	7079	6134	6737

Table 5. Crop coefficients calculated for various growth periods.

Growth period	Barcott	Baretta	Kronos	WB881	Barley	Wheat	All	LSD _{.05}
Planted Nov 29								
2/05 – 2/22	0.62	0.62	0.58	0.71	0.62	0.64	0.63	
2/26 – 3/14	0.83	0.89	0.93	0.97	0.86	0.95	0.91	
3/19 – 3/28	0.81	0.91	0.99	0.95	0.86	0.97	0.92	
4/02 – 4/11	0.89	1.14	1.15	1.12	1.01	1.13	1.07	
4/16 – 4/25	0.75	1.13	1.19	1.14	0.94	1.17	1.05	
5/01 – 5/07	0.60	0.91	1.08	1.07	0.76	1.07	0.92	
5/07 – 5/14	0.48	0.64	0.63	0.63	0.56	0.63	0.60	
5/14 – 5/21	0.48	0.32	0.20	0.23	0.40	0.22	0.31	
5/21 – 6/13	0.15	0.08	0.03	0.04	0.11	0.03	0.07	