

DEFINITION AND APPLICATION OF CROP COEFFICIENTS

Calculation of crop evapotranspiration (ET_c) requires the selection of the appropriate crop coefficient (K_c) for use with the standardized reference evapotranspiration (ET_{os} or ET_{rs}). It is recommended that the abbreviation for crop coefficients developed for use with ET_{os} be denoted as K_{co} and the abbreviation for crop coefficients developed for use with ET_{rs} be denoted as K_{cr} . ET_c is calculated as:

$$ET_c = K_{co} * ET_{os} \quad \text{or} \quad ET_c = K_{cr} * ET_{rs} \quad (68)$$

TRANSFER AND CONVERSION OF CROP COEFFICIENTS

Crop coefficients (K_c) and landscape coefficients available in the literature are referenced to either clipped, cool season grass or full-cover alfalfa. Without appropriate adjustment, crop coefficients for the two references are not interchangeable. For this standardization effort, a grass reference crop is defined as an extensive, uniform surface of dense, actively growing, cool-season grass with a height of 0.12 m, and not short of soil water. A full-cover alfalfa reference crop is defined here as an extensive, uniform surface of dense, actively growing alfalfa with a height of 0.50 m, and not short of soil water.

Grass-based crop coefficients should be used with ET_{os} , and alfalfa-based coefficients should be used with ET_{rs} . If a calculated or measured reference other than ET_{os} or ET_{rs} was used to develop the crop coefficients, it must be established that the reference equation or reference measurements provide values that are equivalent to ET_{os} or ET_{rs} (see Appendix A for comparisons between selected methods). It is important to establish the differences between ET equations since some equations developed to estimate grass or alfalfa reference ET may not agree exactly with ET_{os} or ET_{rs} during all time periods or under all climatic conditions.

K_c values that can be used with ET_{os} without adjustment include those reported in FAO-56 (Allen et al., 1998) and ASCE Manual 70 (Jensen et al., 1990, Table 6.8). Coefficients that can be used as is with ET_{os} for most practical applications are those reported by FAO-24 (Doorenbos and Pruitt, 1977) and SCS NEH Part 623 Chapter 2 (Martin and Gilley, 1993). Coefficients based on the CIMIS Penman equation (Snyder and Pruitt, 1992) should not require adjustment for use with ET_{os} . K_c values that can be used as is with ET_{rs} for most practical applications are those reported by Wright (1982) and ASCE Manual 70 (Jensen et al., 1990, Tables 6.6 and 6.9). There is a tendency for relatively minor overestimation of ET using K_c from Wright (1982) with ET_{rs} in spring and fall. Thus, the K_c values by Wright (1981, 1982) have been converted for direct use with ET_{rs} , with ET_{rs} calculated on a 24-h time step (Allen and Wright, 2002).

Some grass and alfalfa based crop coefficients are “mean” crop coefficients (e.g., Wright, 1979; 1981; Doorenbos and Pruitt, 1977). Mean crop coefficients incorporate the effects of irrigation, rainfall, and soil type at the development site. Users of these mean crop coefficients are cautioned that differences in irrigation frequency, rainfall patterns, and/or soil drying characteristics between the development site and the study site could cause error in the ET_c estimate.

The publications referenced in the above paragraphs contain descriptions on determination and application of crop coefficients during growing periods. This information will not be presented here. The following section discusses the application of ET_{sz} and K_c during non-growing periods.