Journal of Agrometeorology 10(2) : 231-232 (Dec. 2008)

Short communication

Estimation of PET of wheat crop by different methods

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Information on evapotranspiration (ET) of crops of a region is needed for design and operation of irrigation projects. Knowing the area under each crop and their water requirements, it is possible to plan the water resources for storage and distribution from the reservoirs, ponds, lakes etc. Evapotranspiration (ET) is measured both by direct methods (lysimeters) as well as indirect methods (empirical formulas). The empirical methods hold good at the locations where they are developed. The present paper discusses the comparison of three empirical methods used for estimating potential evapotranspiration (PET).

Data on lysimetric evapotranspiration (ET_1) for wheat and different weather parameters from 1983-1987 and 1991-2001 was collected at Indira Gandhi Agricultural University, Raipur (21.16 ^{o}N and 81.36 ^{o}E latitude and longitude). The experimental field was of 1600 m^2 area (40x40m) with two volumetric lysimeters located in the center of the field. The soil of the experimental field was sandy loam. The ambient weather data, *viz.*, mesh covered pan evaporation (Eo) in mm, maximum and minimum temperatures (^{o}C), rainfall (mm), sunshine hours for the period of investigation were recorded from the Agromet Observatory situated adjacent to the experimental field.

Crop evapotranspiration (ET) was estimated using K_c values suggested for wheat by Doorenbos and Pruitt (1977). PET values were estimated using three empirical methods namely Penman, Thornthwaite and Modified Blaney-Criddle (Doorenbos and Pruitt, 1977).

Climatological estimates

The ET_1 and Eo values during different years along with the PET estimated by Penman, Thornthwaite and Blaney-Criddle equations are shown in Table1. In general the estimates of PET by the three methods varied differently in different years.

It was observed that PET estimates by Penman method were lower than the ET_1 values. Thom and Oliver (1977) also examined the validity of Penman's equation in estimating the regional evaporation and they reported that the Penman equation underestimates the ET values in some period of a year. PET estimates by Thornthwaite's method were lower than the ET_1 values in some years while in others it gave overestimated values. Singh *et al.* (1992) also observed that Thornthwaite's equation proves to be highly variable for the estimation of PET. It was seen that Blaney-Criddle estimates overestimated the ET_1 values in most of the years. Rambabu *et al.* (1999) for pigeon pea crop reported that Blaney-Criddle resulted in overestimation of ET_1 over all the periods. Rao and Bhardwaj (1982) used Blaney-Criddle method at New Delhi to compute consumptive use of water for three dwarf wheat varieties and observed the consumptive use values as 352 and 349 mm in 1976-77 and 1977-78 seasons respectively.

Thus, the general trend is that the Thornthwaite and Modified Blaney-Criddle estimates varied considerably in individual years but the Penman PET values were closer to ET_1.

Relationship between evapotranspiration (ET) and climatological estimates

The correlation coefficient (r) between evapotranspiration (ET_1), open pan evaporation (Eo) and potential evapotranspiration (PET) computed by Penman, Thornthwaite and Blaney-Criddle methods are given in Table 2.

It can be seen that there is a significant correlation between ET_1 and Penman values as seen in pattern whereas there is no significant correlation between ET_1 and Eo, Thornthwaite's and Blaney-Criddle's values. It is observed that correlation between Eo and Blaney-

Table1: Seasonal values of lysimetric evapotranspiration (ET_1) mesh covered pan evaporation (Eo) and estimated PET by empirical methods

Year	ET_1 (mm)	Eo (mm)	Penman PET (mm)	Thornthwaite PET (mm)	Blaney-Criddle PET (mm)
1983-84	332.2	378.7	300.1	366.3	454.6
1984-85	348.2	446.6	288.9	380.7	382.4
1985-86	362.9	450.6	294.4	420.5	432.9
1986-87	366.8	394.8	272.7	421.8	433.3
1991-92	478.8	515.2	362.5	400.7	430.6
1992-93	471.8	522.9	343.3	439.3	446.7
1993-94	388.7	408.1	333.5	396.4	438.4
1994-95	442.4	389.9	273.6	409.8	452.9
1995-96	479.5	394.1	385.2	458.0	460.1
1996-97	475.3	457.1	338.4	391.2	403.0
1997-98	427.7	337.9	298.9	348.8	361.7
1998-99	396.0	528.9	415.1	431.9	448.2
99-2000	411.5	446.0	344.0	394.0	472.2
2000-01	459.5	648.2	396.5	431.9	488.8
2001-02	366.3	486.3	316.2	468	486.1

Table 2: Relationship between ET_1 and climatological PET estimates

	ET_1	Eo	Penman	Thornthwaite	Blaney-Criddle
ET_1	1	0.309	0.515*	0.202	0.048
Eo		1	0.648**	0.468	0.466
Penman			1	0.399	0.393
Thornthwaite				1	0.679**
Blaney-Criddle					1

* Significant at 5% level,
** Significant at 1% level

Criddle values are slightly higher than Thornthwaite's value. However open pan evaporation values were significantly correlated with Penman's values. Results show that Penman's method is a better method to estimate the ET_1 values.

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Received: March 2007; Accepted: August 2008