CARIBBEAN FOOD CROPS SOCIETY

PROCEEDINGS

ELEVENTH ANNUAL MEETING

MEASUREMENT AND ESTIMATION OF EVAPOTRANSPIRATION IN FRENCH WEST INDIES

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SUMMARY

Measurement of maximal evapotranspiration (ETM) of crops are compared with potential evapotranspiration (ETP) computations from Penman, Thornthwaite, Blaney–Criddle, Turc, Makkink. Correlations between ETM and solar radiation, insolation or pan evaporation are also calculated for 1966–1969 period. The validity of ETP estimates is discussed either for planned regional irrigation or for water used by crops over short periods.

INTRODUCTION

In tropical areas agriculture have more and more recourse to irrigation. Thus it becomes necessary to know water requirements of crops to be irrigated. We used potential evapotranspiration (ETP) to estimate water requirements of a plant cover because these two data are always correlated for a given locality. Measurements of water use of a crop (maximal evapotranspiration ETM) were compared to results from calculation to verify the validity of several formulae.

MATERIAL AND METHODS

I.N.R.A. Experimental Station has eight square lysimeters (2 m^2 each one) planted with pangola grass *(Digitaria decumbens)* kept in good

growing condition. ETM are measured during a minimal 10 days period. This equipment is completed by a meteorological station: OMM screen, anemometers (2 m and 15 m), heliograph (Campbell – Stokes), pyranometer (Moll), pan evaporation (Class A), rain-gauge.

Formulae used for calculation were chosen according to respective parameters:

THORTHWAITE and BLANEY – CRIDDLE: temperature and daylength,

TURC and MAKKINK: radiation and temperature,

PENMAN: radiation, temperature, humidity, wind and insolation.

Some simple correlations between ETM and global radiation, insolation and pan evaporation were also carried out.

RESULTS AND DISCUSSION

Measured values for ETM (1966 to 1969) were relatively constant from April to September (4 – 5 mm), outside of this period they are lower and more variable (figure 1).

ETP values for 1968 obtained from calculation with different formula and ETM measurements are showed by figure 2. More accurate comparisons are given for the four considered years (Table 1).

Relationships between ETM and

- measured global radiation G
- estimated global radiation G' from insolation (BONHOMME, VARLET GRANCHER, 1973)
- pan evaporation E

were also calculated (Table 2).

Evapotranspiration estimates used to plan regional irrigation and water resource development require only annual ETP. In this case use of BLANEY–CRIDDLE or TURC formulae give very good estimates but other means for calculation gives too low estimates.

To evaluate the water requirements of a crop it is important to estimate ETP with a sufficient accuracy into short periods (10 days for instance). Then it appears that no formula give a very good result and each one has to be adjusted. It therefore seems easier to use relationships between ETM and global radiation or insolation or pan evaporation (Table 2). However these statistical adjustments are not valid in all conditions and the ability to extrapolate these results for other areas has to be checked.

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Figure 1

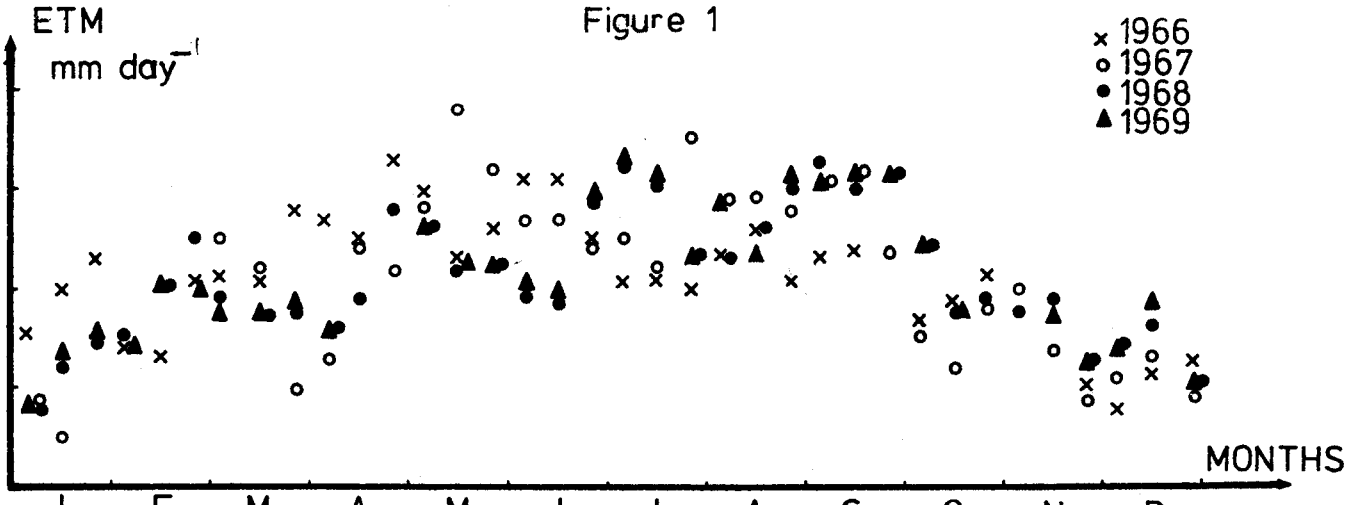

Figure 2

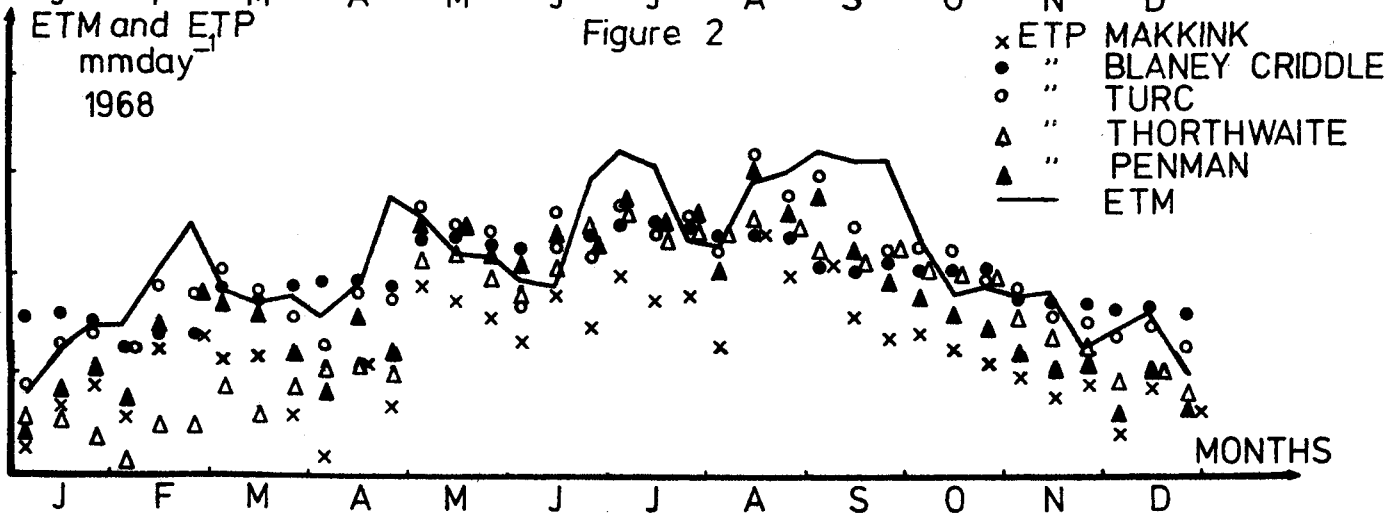

Table 1

Correlations between ETP (computed) and ETM (measured) 1966 – 1969

ETM = a ETP + b; daily mean for a period of ten days; n = 150

r: regression coefficient

$\sigma_{y,x}$: standard deviation from regression

ETP	a	b	r	$\sigma_{y,x}$	Annual ETM/ETP
PENMAN	0,72	1,5	0,72	0,5	0,88
MAKKINK	0,97	0,9	0,72	0,5	0,79
BLANEY–CRIDDLE	1,18	– 0,7	0,72	0,6	0,99
TURC	0,86	0,6	0,67	0,6	0,98
THORTHWAITE	0,63	1,8	0,62	0,6	0,88

Table 2

Relationships between ETM and climatic factors 1966 – 1969

ETM = a X + b; daily mean for a period of ten days
n = 150

X	a	b	r	$\sigma_{y,x}$
global radiation G measured cal cm^{-2} day^{-1}	0,008	0,6	0,74	0,5
global radiation G' estimated from insolation ✶	0,008	0,5	0,68	0,6
Pan evaporation E "Class A", mm day^{-1}	0,54	1,5	0,73	0,6

✶ $G' = G_o\ (0{,}26 + 0{,}51\ s/s_o)$ for Guadeloupe
G_o (extraterrestrial radiation) and s_o (daylight) given by tables; s measured by heliograph.