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***Short communication***

# Agroclimatic study of rainfed sorghum grown in lysimeter

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Evapotranspiration is the vital process in plant system. It is proved in research that the ratio between actual yield and potential yield is directly proportional to the ratio between the actual evapotranspiration and potential evapotranspiration. It is understood that the actual evapotranspiration is greatly influenced by atmospheric, soil and plant factors. Considering this, a study was made to investigate the relationship between (i) grain yield (Y) and seasonal rainfall (RF), effective rainfall (ERF), growing degree days (GDD), relative temperature disparity (RTD), relative humidity disparity (RHD), helio-thermal unit (HTU), and change in soil moisture $\Delta S$ (ii) lysimeter evapotranspiration (ET) and RF and ERF, and (iii) between duration of sorghum crop (D) and GDD, RTD and HTU.

The study was undertaken under dry land situation for seven years (1997-98 to 2003- 04). The test crop sorghum (variety: COS-28) was sown in the 3 lysimeter at a spacing of 30x15 cm with 45 plants maintained in each lysimeter. In and around lysimeter up to a distance of 15 meters the same sorghum crop was raised and recommended cultural practices were adapted in both the lysimeter and outside. Evapotranspiration (ET) was recorded daily from the lysimeters and the average ET was summed up for the crop duration. Effective rainfall was computed as reported by Gupta *et al* (1972). Growing degree days (GDD) were calculated for sorghum crop based on the base temperature of $18^0$C as reported by Karthikeyan (2002). Similarly RTD and RHD were calculated following Karthikeyan (2002).

Statistical relationships were developed through correlation and step down regression. The mean data on crop yield and weather parameters for different years are presented in Table 1. Five years (1999-2000 to 2003-04) data were used for development of model and 2 years (1997-98 to 1998-99) data were used for validation.

In general when rainfall was more, the sorghum grain yield also enhanced. The simple correlation between grain yield (Y) and weather parameters did not indicate any significant relationship. Hence multiple regressions were attempted between Y and ERF; GDD, and between Y and. RHD and RTD, which explained 38 to 59% of grain yield variation. The equations are;

**Table 1:** Dependent and independent variables data set.

| Year | Dependant variables | | Independent variable | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain yield kg ha$^{-1}$ | Evapotranspiration mm | Duration of crop days | Rainfall (mm) | Effective rainfall (mm) | GDD ($^0$C) | RTD | RHD | HTU $^0$Chr |
| 1999-2000 | 4230 | 322 | 119 | 463 | 280 | 805 | 36 | 43 | 4848 |
| 2000-2001 | 1634 | 277 | 106 | 135 | 130 | 629 | 35 | 45 | 4560 |
| 2001-2002 | 2564 | 393 | 114 | 535 | 338 | 862 | 34 | 41 | 5030 |
| 2002-2003 | 2209 | 343 | 120 | 349 | 258 | 894 | 40 | 53 | 5585 |
| 2003-2004 | 1331 | 380 | 123 | 315 | 274 | 896 | 41 | 53 | 6252 |
| Validation data | | | | | | | | | |
| 1997-1998 | 1390 | 401 | 128 | 557 | 308 | 981 | 38 | 47 | --- |
| 1998-1999 | 1500 | 429 | 119 | 620 | 451 | 923 | 34 | 38 | --- |

**Table 2:** Validation of models

| Eqn No. | Dependant variables | Independent variables | Years of crop | Predicted value | Observed value | Difference | % of difference |
|---|---|---|---|---|---|---|---|
| 1 | Grain yield (Y) | ERF & GDD | 1997 -1998 | 1769 | 1390 | 379 | 27 |
| | | | 1998 -1999 | 4479 | 1500 | 2979 | 199 |
| 2 | | RTD & RHD | 1997 -1998 | 2978 | 1390 | 1588 | 114 |
| | | | 1998 -1999 | 4553 | 1500 | 3053 | 203 |
| 3 | ET | ERF | 1997 -1998 | 371 | 401 | 30 | 7.0 |
| | | | 1998 -1999 | 447 | 429 | 18 | 4.0 |
| 4 | Crop duration (D) | GDD | 1997 -1998 | 126 | 128 | 2 | 1.5 |
| | | | 1998 -1999 | 122 | 119 | 3 | 2.5 |
| 5 | | RTD | 1997 -1998 | 1 18 | 128 | 10 | 7.8 |
| | | | 1998 -1999 | 111 | 119 | 8 | 6.7 |

$Y=5675.088+16.62ERF-9.2GDD$
($R^2=0.382$)

$Y= -1034.98 + 715.14RTD - 492.82RHD$
($R^2=0.593$)

Correlation between ET and RF & ERF indicated that the ET has a significant correlation with ERF alone (r=0.88). Further, a step down regression showed that ERF alone had higher contribution to evapotranspiration (ET = 206 + 0.535 ERF) with $R^2$ of 0.78.

A high correlation value of 0.88 was obtained between duration of crop (D) and GDD. Gillmore and Rogers, (1958), used heat unit concept as a method to measure the maturity of corn. The step-down regression analysis indicated the significance of GDD with respect to crop duration (D). The equation is, D=73.394 + 0.05263 GDD with $R^2$ = 0.778. The equation between crop duration (D) and RTD was also significant (D=56.38 + 1.61 RTD with $R^2$ of 0.570).

The derived equations were validated with two years data of 1997-98 & 1998-99 (Table 2). Though the derived model could not satisfactorily predict yield, the prediction made using ERF for ET, GDD for Crop duration were closer.

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