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Short communication

Predicting grain yield in maize: canopy temperature based regression indices

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The plant water status is a primary determinant of grain yield. A means for evaluating water status by remote measurements could open a new way for improving yield prediction. Several canopy temperature based indices have been developed to quantify plant water stress which have been used in grain yield prediction. canopy temperature based parameters have been found to give good relation with yield. Here an attempt has been made to develop regression models for explaining the yield relationship for summer maize.

A field trial was conducted during summer 1991 at Punjab Agricultural University farm, Ludhiana (30°54'N, 75°56'E and altitude 247 m above mean sea level). This area is characterized by semi-arid, subtropical type of climate with very hot summer during April-June having air temperature ranges between 40 and 45°C, which receives 261 mm of rainfall during summer crop season (May-June). Four soil moisture regimes were maintained by scheduling irrigation (75 mm) to the crop on cumulative pan evaporation (CPE) basis (viz. 125, 100, 75 and 50 CPE) for two dates of planting (25.4.91. and 6.5.91). Each treatment was replicated four times in Randomized Block Design. During crop growth the canopy temperature and canopy air temperature were recorded periodically by infrared thermometer keeping one meter above the canopy inclined at angle of 45° during 1430 hours on clear sky days. The canopy temperature based indices used for grain yield prediction were

a) Average canopy temperature (Tc) (Singh and Kanemasu, 1983)

b) Average canopy - air temperature differential (Tc-Ta) (Singh and Kanemasu, 1983)

c) Summation stress degree days (ΣSDD) (Idso *et al.*, 1977)

d) Average crop water stress index (Av.CWSI) (Idso *et al.*, 1981)

Average canopy temperature and canopy - air temperature differential for the reproductive period of the crop were calculated by summing up the daily mid afternoon canopy temperature values recorded for each treatment and dividing by the number of observations. The average CWSI for each treatment was calculated in the same manner for the said period. Stress degree days for each treatment was calculated by summing up the canopy - air temperature differential values obtained for each day for the reproductive period. The stress indices were used for predicting the grain yield by developing regression models.

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Table 1: Grain yield and canopy temperature based indices as influenced by treatments.

Dates	Treatments	Grain yield (t ha^{-1})	Av.Tc (°C)	Average Tc-Ta (°C)	ΣSDD (°C-day)	Average CWSI
D_1	T_4 (50 CPE)	0.24	36.4	-4.0	-413.8	0.36
D_2	T_4 (50 CPE)	0.20	38.7	-3.1	-284.7	0.51
D_1	T_3 (75 CPE)	0.20	37.7	-3.6	-301.3	0.42
D_2	T_3 (75 CPE)	0.17	39.6	-2.1	-201.5	0.61
D_1	T_2 (100 CPE)	0.15	40.1	-1.5	-80.4	0.72
D_2	T_2 (100 CPE)	0.13	40.5	-0.3	-42.3	0.79
D_1	T_1 (125 CPE)	0.13	41.3	0.6	34.7	0.71
D_2	T_1 (125 CPE)	0.12	42.5	1.2	750.8	0.87
	$CD_{0.05}$ (± S•E)					
	Date	1.0(0.61)	1.08 (0.84)	0.46 (0.23)	10.63 (4.96)	0.038 (0.02)
	Treatment	1.2 (0.81)	2.60 (1.19)	0.66 (0.32)	15.04 (7.01)	0.053 (0.03)
	Date x Treatment	NS (1.00)	NS (1.69)	0.93 (0.45)	21.27 (9.92)	0.76 (0.36)

Under first date of planting maximum grain yield (0.24 th^{-1}) was observed under unstressed condition. The delay in planting by a fortnight resulted in a decline in grain yield by 0.04 t h^{-1}. A similar trend was observed under relatively stressed to stressed condition (T_3-T_1), whereas the delay in planting showed an increasing trend of average canopy temperature, average canopy - air temperature difference, summation SDD and average CWSI. These indices under unstressed conditions showed an edge over the stressed co0ndition (Table 1).

The following simple liner regression models were developed :

$$Y = 101.96 - 2.14\ Tc \qquad R^2 = 0.94$$

$$Y = 13.16 - 2.17\ (Tc - Ta) \qquad R^2 = 0.90$$

$$Y = 12.60 - 0.04\ \Sigma SDD \qquad R^2 = 0.83$$

$$Y = 31.97 - 24.21\ CWSI \qquad R^2 = 0.87$$

where y is grain yield in t ha^{-1}.

The average canopy temperature based model was found to be the best fit in predicting grain yield followed very closely by average canopy - air temperature difference regression models which explained 94 and 90 per cent variation in grain yield respectively.

Similar relationship of grain yield with different canopy temperature based indices have been reported by several workers on different crops under varied environments (Diaz *et al.*, 1983, Singh and Kanemasu, 1983, Idso *et al.*, 1977, Diaz *et al.*, 1983, Walker and Hatfied, 1979.

This indicates that average canopy temperature and average canopy - air temperature differences during the reproductive phase of maize crop has an ample scope to serve as an important tool for grain yield prediction.

REFERENCES

Diaz, R.A., Mathias A.D. and Hanks R.J. 1983. Evapotranspiration and yield estimation of spring wheat from canopy temperature. *Agron. J.*, 75:805-810.

Idso, S.B.: R.D. Jakson, Printer P.J., Jr., Reginto R.J. and Hatfield J.L., 1981. Normalizing the stress degree day parameter for environmental variability. *Agric. For. Meteorol.*, 24 :45-55

Idso, S.B.; Jackson R. D. and R. J. Reginato. 1977. Remoto sensing of crop yield. *Science*, 196 : 19-25

Singh, Piara and Kanemasu E.T., 1983. Leaf and canopy temperature of pearl millent genotypes under irrigation and nonirrigation conditions. *Agron. J.*, 75: 477-501

Walker, G.K and Hatfield J.L., 1979. Test of the stress - degree day concept using multiple planting dates of seed kindly beans. *Agron. J.*, 71:967-971.