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Short Communication

Radiation interception by fingermillet crop in Bangalore region

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Solar radiation being a major controlling factor for crop growth, has been studied by several scientists (Andre and Viswanathan 1983; Charles-Edwards and Thornley, 1973; Rajegowda, *et al.*, 1988, 1991 and Sanjeevakumar *et al.*, 1997). According to Lee *et al.* (1987) light passing through the leaves attenuates 3.4% of sunlight. Ehleringer (1981) has studied the leaf absorptance of Mohave and Sonoran desert plants. A study on the relationship between the leaf area of single plant and their light absorption have been examined theoretically by Charles-Edwards and Thornley (1976). Light exerts many stimulating effects on plants especially upon the differentiation of organs. Here an attempt has heen made to determine the relationships between intercepted energy with leaf area index and total biomass in the crop of finger millet at different growth stages.

Fingermillet crop (Ragi) was sown on two different dates (S_1 - 1.8.97; S_2 - 13.8.97) during the south-west monsoon at G.K.V.K., Bangalore (altitude 930 m amsl longitude 77°33'E and latitude 12°50'N). The crop was raised following the standard package of practices with 30 cm. intra row spacing and 15cm. inter plant distance under rainfed condition. Hourly solar radiation observations of direct (D), reflected (R) and transmitted (T) components were measured in the crop canopy using integrating Pyrano meter sensor (PY - 7178). Leveling of radiometer was ensured with the help of spirit level mounted on the base of the radiometer. Observations were made once in a week from morning 8.00 hrs to the evening 17.00 hrs at hourly interval. Plant height, leaf area index (LAI) and total dry matter (TDM) produced were recorded at each phenological stage of crop. The LAI and TDM were computed by graphical interpolation for the dates of observations of radiation. The intercepted radiation (I) was computed using the formula $I = D - (R+T)$. The radiation components during different stages were related with the LAI and TDM and expressed as simple linear regression equations.

The solar radiation observations were started after 30 days after sowing of 1st date crop and 17 days after sowing of 2nd date crop. The leaf area index (LAI) and the total dry matter (TDM) is given in the Table 1.

Simple linear regression equations were worked out between percentages of intercepted radiation at particular hour and LAI and TDM. The computed equations showed the better relation for the measurement made during 11.00 hour, 12.00 hour 15.00 hour with relatively high value of 'r'.

For 11th hour observation

$Y_{TDM} = 27.72X_i + 1177.381 \quad r = 0.71$

$Y_{LAI} = -0.036\,X_i + 6.486 \quad r = 0.45$

Table 1 : LAI and TDM of Fingermillet crop.

Date	LAI		TDM (gm^{-2})	
	I date	II date	I date	II date
08/10	5.1	3.8	1194.23	1026.21
15/10	5.7	4.3	1449.03	1380.48
29/10	6.0	5.2	1845.23	2089.02
05/11	6.2	5.7	2231.58	2374.69
12/11	6.5	6.1	2699.23	2685.18
21/11	5.3	6.3	3126.13	3164.16
26/11	3.6	5.8	3188.17	3293.93
03/12	0.5	3.9	3274.98	3372.96
10/12		2.1		3411.18
17/12		0.3		3449.40

For 12th hour observation

$Y_{TDM} = 25.85X_i + 1284.966 \quad r = 0.64$

$Y_{LAI} = -0.038\ X_i + 1.789 \quad r = 0.42$

For 15th hour observation

$Y_{TDM} = 17.82X_i + 1635.569 \quad r = 0.47$

$Y_{LAI} = -0.057\ X_i + 7.376 \quad r = 0.65$

Where, Y_{TDM} and Y_{LAI} are total dry matter and leaf area index respectively and X_i is the percentage of solar energy intercepted at different hours of observation.

The solar radiation components for both dates are given in Table 2. The maximum D of 25.4 MJ m^{-2} received on 1st date sown crop was on 15/10, and the highest interception of 17.5 MJ m^{-2} was on 26/11 which was observed two days before the crop harvest. The D was almost same in second date crop with some marginal variations.

From Table 2 it is observed that on 15/10 in the 1st date crop, the per cent of I increased and R decreased but they got reversed during later observations i.e. is on 29/10 and 05/11. The increase in I and decrease in R was observed at ear emergence stage in both dates of sowing. The reverse trend in I and R was observed during 50% flowers in ear head. The interception of more radiation lead to the accumulation of more TDM in further stages. As LAI increased the intercepted radiation (I) also increased. The T at ground surface was almost negligible during later stages. With decreasing LAI and increasing TDM, the interecepted radiation kept on increasing. Sanjeeva Kumar *et al.* (1997) has observed the same trend.

Hourly values of the radiation components were integrated graphically from one phenological stage to another stage and the total radiation components in each stage given in Table 3. Although 13 days difference is there between two dates of sowing, both crops were exposed to almost same amount of radiation. The slight variation of total amount may be attributed to varying cloud cover. Both crops showed similar response to T and I with marginal differences in the amount of energy reflected, transmitted and intercepted.

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Table 2 : Solar radiation (MJm^{-2}) observations during the crop growing period on two dates of sowing (S_1 and S_2).

Date	S_1 (1.8.97)				S_2 (13.8.97)			
	D	R	T	I	D	R	T	I
08/10	19.4	6.9	5.6	6.93	18.6	5.9	8.7	4.1
15/10	25.4	7.2	3.7	14.5	25.1	7.6	7.9	9.7
29/10	14.3	4.3	3.1	6.9	12.8	4.2	2.2	6.4
05/11	20.1	4.3	5.1	10.7	15.7	5.3	4.0	6.4
12/11	23.0	5.7	4.0	13.3	23.9	5.3	7.2	11.4
21/11	12.2	3.5	1.9	6.9	12.9	3.0	3.7	6.2
26/11	25.7	4.8	3.4	17.5	18.4	4.3	3.5	10.5
03/12	23.9	3.8	4.1	16.1	22.2	3.9	4.9	14.1
10/12	----	----	----	----	24.5	4.6	3.2	16.7
17/12	----	----	----	----	17.8	2.8	2.6	12.4

Table 3 : Integrated components of radiation (MJm^{-2}) at different phenological stages for two dates of sowing in finger millet.

Phenological stages	Days of interval		D		I		R		T	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Beginning of tiller	47	42	941.4	804.5	25.0	17.6	22.2	16.9	894.2	770.1
Ear emergence	26	35	490.7	672.2	286.1	361.4	102.0	165.6	102.5	145.3
50% flowering	18	12	420.4	189.3	197.7	89.2	154.4	77.8	68.3	22.3
Grain formation	18	14	316.8	238.9	197.8	140.2	108.2	45.5	10.9	53.2
Harvest	17	14	305.7	554.7	201.1	343.6	65.1	62.1	39.5	149.0
Total	126	127	2475.1	2459.6	907.7	952.0	451.9	352.9	1115.4	1140.3

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