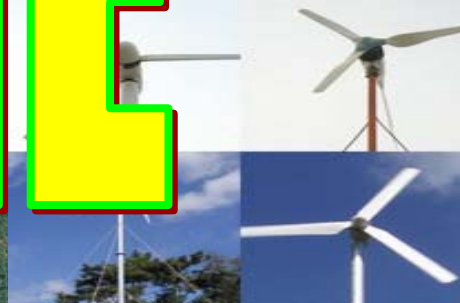
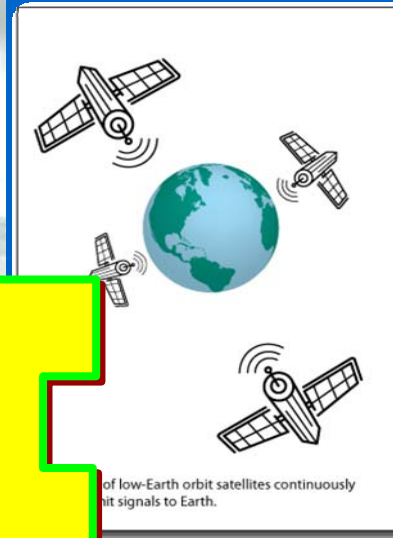
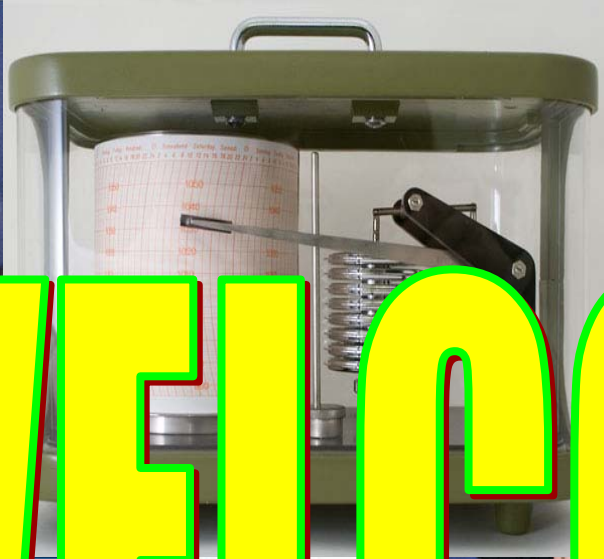


WELCOME



Evapotranspiration Measurement in Wheat (*Triticum aestivum* L.) from Tarai Region of Uttrakhand using Blaney-Criddle, Jensen-Haise and Modified Penman Methods

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INTRODUCTION

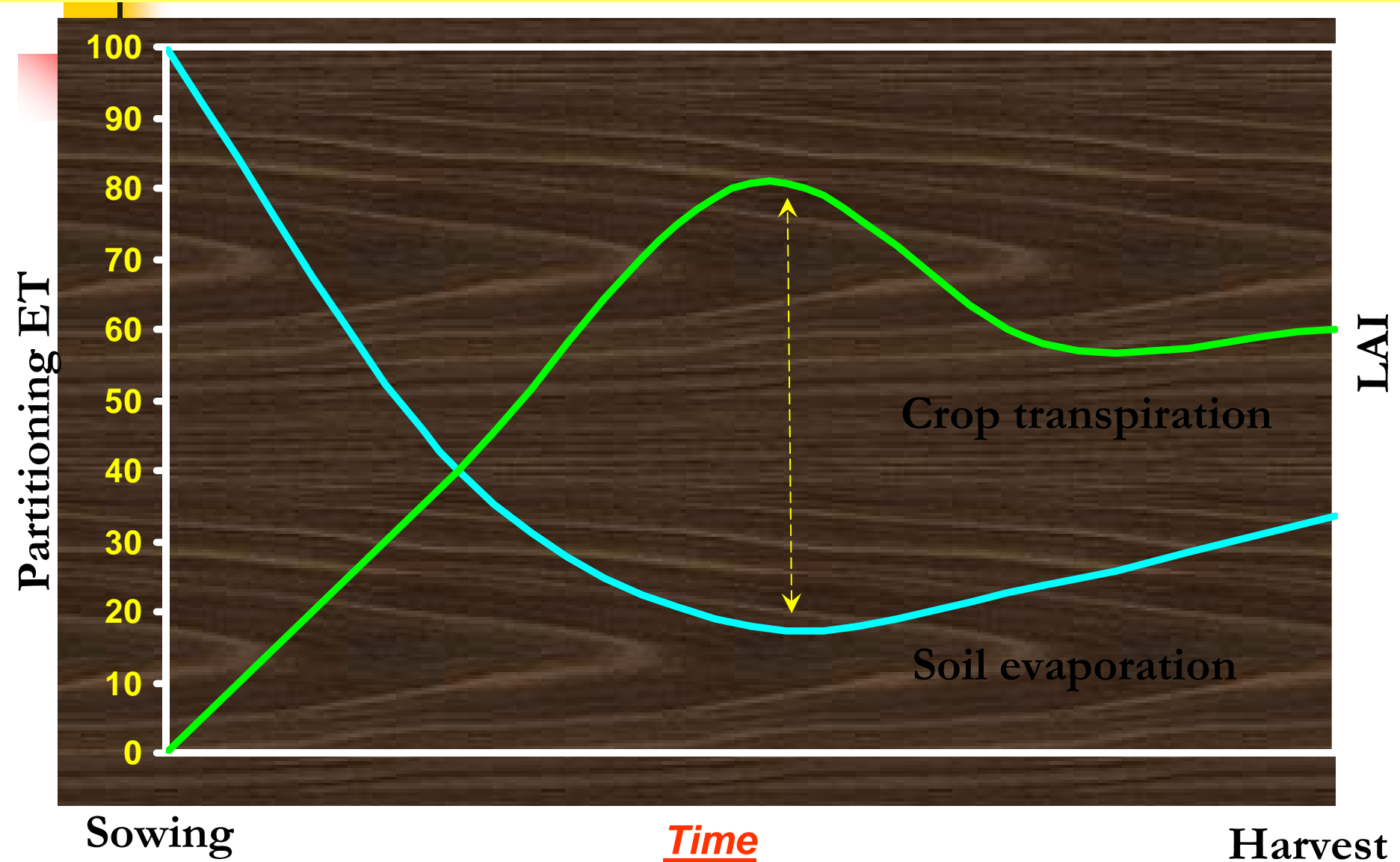
- **Wheat (*Triticum aestivum* L.) is very important crop in the Uttarakhand region which is grown from November-December and harvested from March-April.**
- **Evapotranspiration (ET) is a biophysical processes and this happens in crop's life cycle from germination to harvest.**
- **Evaporation is a physical processes in which liquid change in to gas.**
- **Transpiration is a biological processes by which water vapour leaves the living plant body and enters in the atmosphere.**
- **Potential evapotranspiration (PET)- water loss from extended surface of green vegetation of uniform height which exert no resistance to flow of water.**

- **Reference evapotranspiration (ET_o):** Reference evapotranspiration is defined as "the rate of evapotranspiration from a hypothetical reference crop with an assumed crop height of 0.12 m (4.72 in), a fixed surface resistance of 70 sec m⁻¹ (70 sec 3.2ft⁻¹) and an albedo of 0.23, closely resembling the evapotranspiration from an extensive surface of green grass of uniform height, actively growing, well-watered, and completely shading the ground.
- Reference evapotranspiration may be calculated by the US class A open pan evaporimeter by the following equation.

$$ET_o = K_p \times E_{pan}$$

Where E_{pan} is the measured value of evaporation by US class A open pan evaporimeter and K_p is pan coefficient.

Effect of ET on Plant Growth



MATERIALS AND METHODS

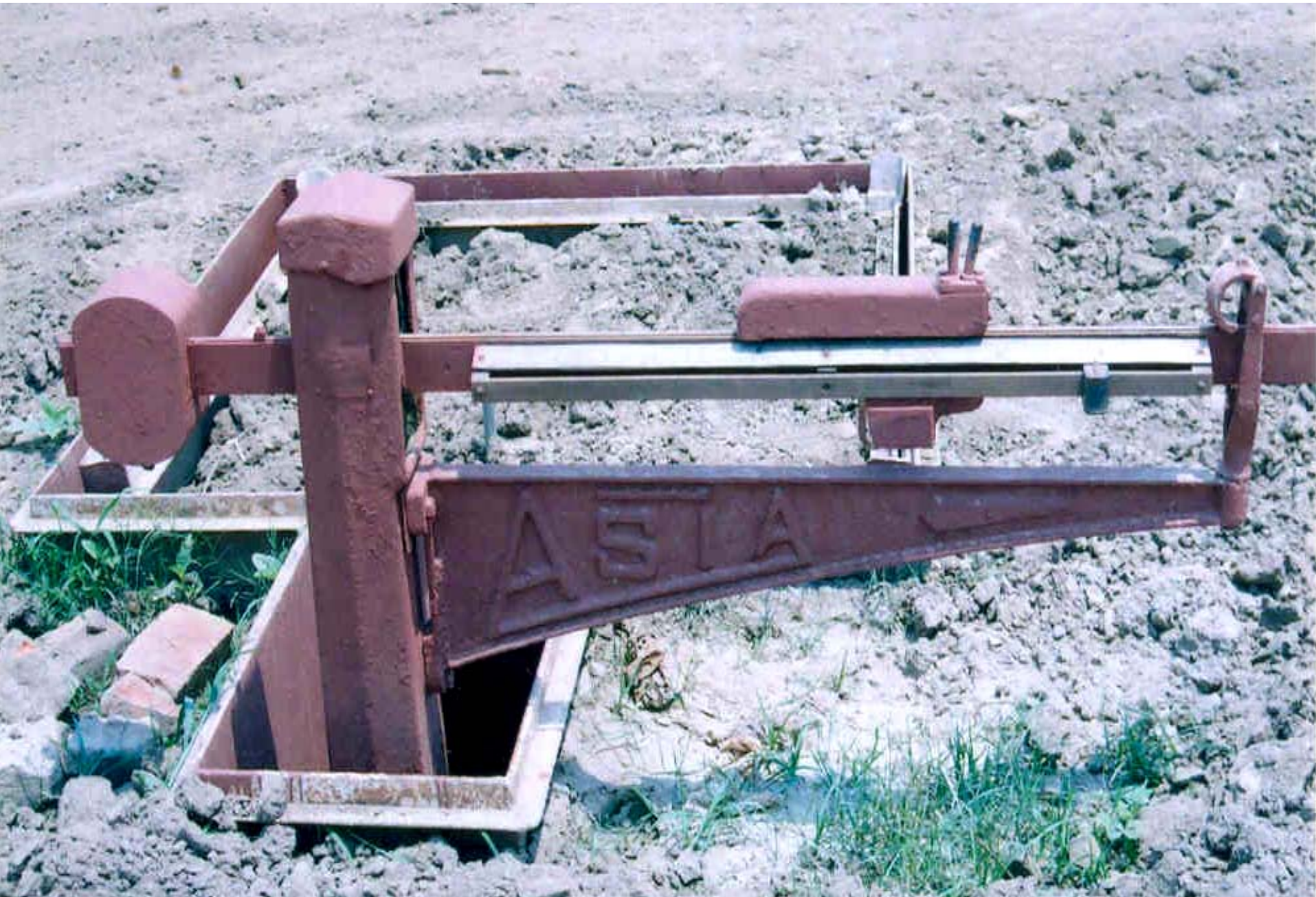
- The present study was conducted in co-operation with the India Meteorological Department (IMD) at the Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, which is situated at 29.1°N latitude, 79.3°E longitude and at an altitude of 243.8 m above mean sea level.
- The area lies in 'tarai' belt located in foot hills of the Himalayas. The area has a sub-humid subtropical climate. The annual total rainfall in the area is about 1400 mm of which 80 per cent is received from mid June to September.
- Wheat (*Triticum aestivum* L.) Genotype. 3264 was sown in *rabi* season of 2007-2008. The same crop was also grown around the weighing lysimeters to provide a natural and identical environment to the crop grown in the lysimeters.
- The ET of Wheat was estimated separately on weekly basis by the following mathematical models:

(1) Blaney-Criddle method

(2) Jensen and Haise method

(3) Modified Penman method

Weighing Type Lysimeter



Blaney-Criddle method

$$ET_0 = C [P (0.46T + 8)] \text{ mm/day}$$

Where,

ET_0 = Reference crop ET in mm day⁻¹

T = Mean daily temperature in °C

P = Mean daily percentage of total annual day time hours

C = Adjustment factor which depend upon relative humidity, sunshine hours and day time wind estimates.

[Blaney and Criddle, 1950]

Jensen-Haise method

$$ET_{JH} = (0.24T + 0.88) \times RS$$

where,

T = Air temperature (°C)

RS = solar radiation (mm H₂O day⁻¹)

ET_{JH} = Jensen-Haise ET (mm day⁻¹)

[Jensen and Haise, 1963]

Modified Penman Methods method

$ET_o = C \{ W.R_n + (1 - W) f(u) (e_a - e_d) \}$ where,

ET_o = Reference crop ET in mm day⁻¹

C = Adjustment factor to compensate for the day and night weather effects

W = Temperature related weighing factor for the effect of radiation on ET_o

R_n = Net radiation

$(1-W) f(u) \cdot (e_a - e_d)$ = aerodynamic term

[Doorenbos and Pruitt, 1977]

RESULTS AND DISCUSSION

The outcomes have been presented through tables. The salient findings of experiment have been categorized and presented as under:

- **Week wise ratio of measured ET and pan evaporation (ET/EP) for wheat (table 1).**
 - **Relation between measured and Estimated ET by different mathematical method for wheat crop. (table 2).**
- 1. Relationship between measured ET and estimated ET by Blaney-Criddle method.**
 - 2. Relationship between measured ET and estimated ET by Jensen-Haise method.**
 - 3. Relationship between measured ET and estimated ET by Modified Penman Methods method.**

Table : Week wise ratio of measured ET and pan evaporation (ET/EP) for wheat

Wheat		
Std. Weeks	Weeks	ET/EP
49	03-09 Dec.	0.69
50	10-16 Dec.	0.23
51	17-23Dec.	0.36
52	24-30 Dec.	0.42
01	01-07 Jan.	0.00
02	08-14 Jan.	1.11
03	15-21 Jan.	1.69
04	22-28 Jan.	1.22
05	29Jan.-04Feb.	0.39
06	05-11 Feb.	1.69
07	12-18 Feb.	1.18
08	19-25Feb.	2.42
09	26Feb.-04 Mar.	1.83
10	05-11 Mar.	0.70
11	12-18Mar.	1.80
12	19-25 Mar	0.44
13	26Mar.-01Apr	0.95
14	02-08 Apr	0.55
15	09-15 Apr.	0.17
Mean		0.93

Table 2. Relation between measured and Estimated ET by different mathematical method for wheat crop.

	Blanney-Criddle	Jensen-Haise	Modified Penman
No. of pairs	19	19	19
Mean measured ET (mm/day)	2.45	2.45	2.45
Mean estimated ET (mm/day)	2.25(ET_u)	2.4 (ET_j)	2.46 (ET_p)
Over (+) under (-) estimation (%)	-8.6	-2.04	+0.40
Correlation Coefficient	0.573*	0.615**	0.930**
Regression equation	ET=0.268+0.97ET_u	ET=0.571+0.786ET_j	ET= -0.339+1.13ET_p

Results

- **Statistical analysis of measured ET with estimated ET by Blaney-Criddle method, It is evident that this method overestimated evapotranspiration by 8.16 per cent for wheat crop. For wheat crop season the average ET was 2.45 mm/day but the method estimated 2.25 mm/day. The correlation coefficient for wheat it is 0.573*.**
- **Measured ET and estimated ET by Jensen-Haise method, the average measured ET for wheat crop was 2.45 mm/day while this method estimated 2.4 mm/day. The correlation coefficient for wheat it is 0.615.**
- **Modified Penman method, wheat average rate of estimated ET is 2.46 mm/day while the average measured ET by the lysimeter was 2.45 mm/day. This method overestimated the ET by 0.4 per cent. The correlation coefficient for wheat it is 0.930.**

CONCLUSION

- The evapotranspiration of wheat under Uttarakhand *Tarai* conditions is about 326.3 mm. The total rainfall during wheat season is 27.4 mm and it is very less. Thus irrigation is required during the crop season.
- The models showed almost identical results in the determination of ET. On the overage, the Blaney-Criddle method (r 0.573) gave the lowest as comparison to other empirical methods.
- The Modified Penman method provides a good agreement with the observation (r 0.930), the Modified Penman method has been recommended for future application in this region.



Thank You

