

**Short Communication**

**CROP CO EFFICIENT AND CROP WATER REQUIREMENT OF  
MUNG BEAN (*VIGNA RADIATA* L.) IN DL1b AGRO  
ECOLOGICAL REGION OF SRI LANKA**

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**INTRODUCTION**

Mung bean (*Vigna radiata* L.) is an important pulse crop in the Dry Zone of Sri Lanka and it is being used as a third season cultivation crop, in which mungbean is cultivated after the paddy harvest using residual moisture in the paddy land with supplementary irrigation. At present, farmers are opting for mung bean under irrigation due to changing pattern and uneven distribution of rainfall. However, water requirement data and crop coefficient of mung bean is not locally available.

Crop co-efficient ( $K_c$ ) values are required for estimating crop evaporation (Hossain and Islam, 2010). There was no variety specific crop co-efficient value for mung bean grown in Sri Lanka. Food and Agriculture Organization uses Crop coefficient value of green gram with 110 days duration cultivar. This study aims to introduce specific and accurate  $K_c$  values for mung bean grown in Sri Lanka which takes only 65 days to mature. Crop coefficient ( $ET_c/ET_o$ ) which is the ratio of crop evaporation ( $ET_c$ ) to evapotranspiration ( $ET_o$ ), is an important parameters in irrigation management (Allen *et al.*, 1998). As the actual crop water requirement for local crops such as mung bean is not known, wastage of irrigation water is high. Physiological characteristics of crop varieties differ under different soil and climatic conditions, thus, showing varying physiological demand of crop water requirement. Hence, real state  $K_c$  value is important for proper irrigation scheduling and efficient water management. Therefore, the objective of this research was to determine the crop water requirement and the crop co-efficient at different stages of the productive cycle of a mung bean variety MI-6 using a field lysimeters.

**MATERIAL AND METHODS**

The study was conducted at the Grain Legumes and Oil Crops Research and Development Centre (GLORDC), Angunakolapelessa, Sri Lanka, from October, 2012 to

February 2014. This research station is situated in DL1b agro ecological region of Sri Lanka. Two set of 3 × 3 m drainage type field Lysimeters were constructed and used for this study to measure water balance parameters.

Mung bean was sown in Lysimeters tank and to maintain a similar environment; the same crop was grown in the land surrounding the tank. Mung bean plant spacing was 30 × 15 cm. The crop protection and other cultural practices were carried out as recommended by the Department of Agriculture. Water balance data were collected and calculated daily in the growing period by applying the mass continuity equation and the consumptive water use was obtained by the difference between the soil inputs and outputs.

$$ET_C = (P + I) - D - ES \pm \Delta A \dots \dots \dots (1)$$

Where,  $ET_C$  is the crop evapotranspiration (mm), P-the rainfall (mm), I-the irrigation, D-the drainage (mm), ES-the superficial runoff, and  $\Delta A$  the soil water storage variation (mm). Soil water status was monitored using gypsum blocks installed inside the lysimeters at different depths.

CROPWAT for windows is a program that uses the FAO (1992) Penman-Montieth methods for calculating reference crop evapotranspiration ( $ET_0$ ). Daily maximum temperature, daily minimum temperature, relative humidity, sunshine hours and wind speed were collected from Agro metrological station, GLORDC, Department of Agriculture and data were incorporated to the CROPWAT to estimate ( $ET_0$ ). The crop co-efficient was calculated according to following equation (Burt *et al.*, 2005).

$$ET_C = K_C \times ET_0 \dots \dots \dots (2)$$

Where the  $K_C$  is the crop co-efficient and  $ET_0$  is the reference evapotranspiration and  $ET_C$  is the crop evaporation

## RESULTS AND DISCUSSION

### Reference evapotranspiration ( $ET_0$ )

The CROPWAT software developed by FAO based on Penman Montieth method used to estimate reference evapotranspiration ( $ET_0$ ) incorporating weather data. Trend of  $ET_0$  during the crop duration is presented in Figure 1. The differences in  $ET_0$  could be

attributed to the combined effects of temperature variations, sunshine hours, radiation, wind speed and relative humidity.

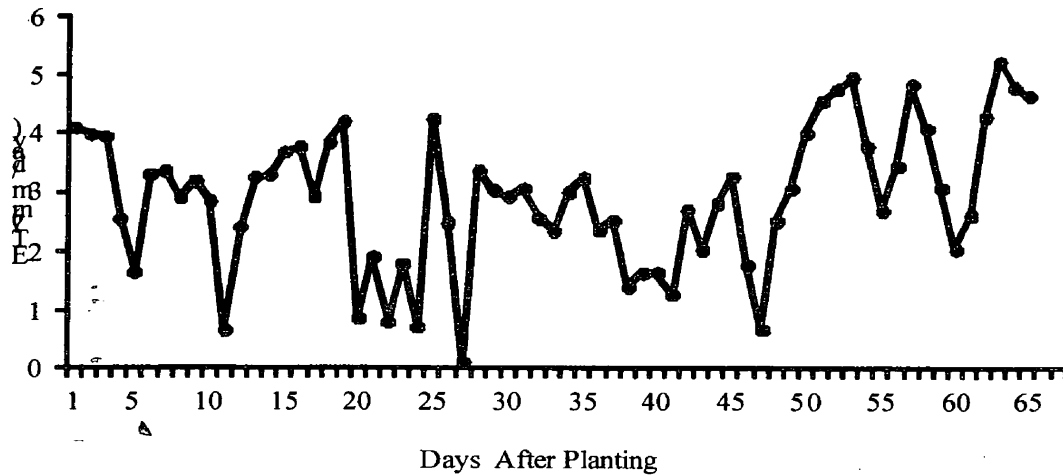


Figure 1. Daily reference evapotranspiration during *maha* season.

**Consumptive water use (ET<sub>C</sub>)**

Using the water input, output and storage data, the daily crop water consumption (Etc) was calculated. The internationally recognized crop growth stages for the calculation of crop coefficients are initial, development, midseason and late season stages. The duration of each stage depends on the length of growing season of the crop and climate (Doorenbos and Pruitt, 1977; Smithy, 1992). Considering mung bean, local climate and length of growing season following stages and durations were used in this study.

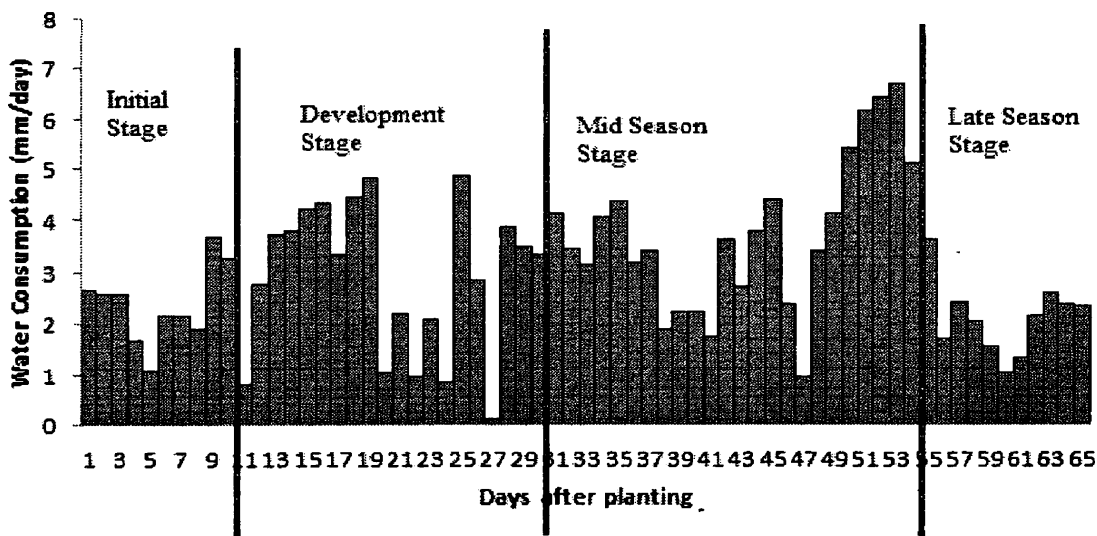


Figure 2. Daily consumptive water usage of Mungbean *maha* season.

There was no definite pattern for daily crop water use with respect to crop age as the value was fluctuating throughout the crop growing season. Cumulative consumptive water use curve was constructed using cumulative crop ET against days after sowing. Figure 3.

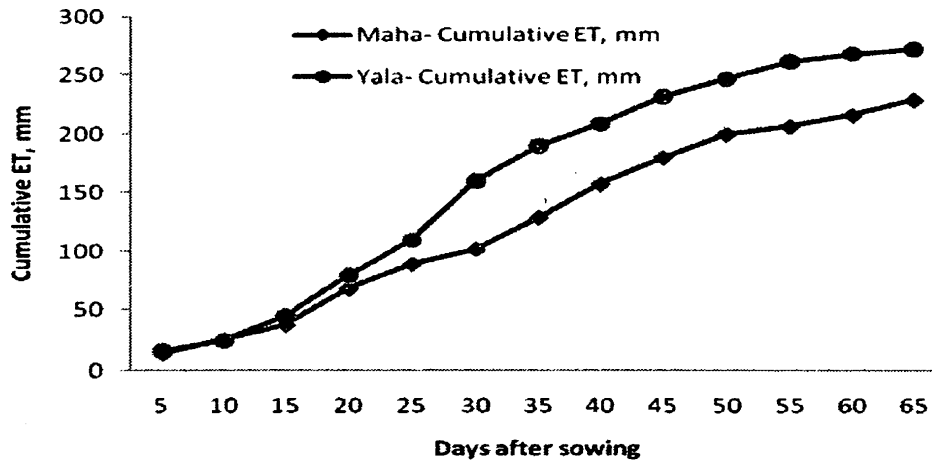


Figure 3. Relationship between cumulative ET and days after sowing.

### Crop coefficient ( $K_C$ )

The values of Mung bean crop water requirement and crop coefficient obtained in this study are presented in Table 1 and 2 for consecutive seasons. Water requirement and crop co-efficient were high for development and mid season stages in both seasons, as this is the period coincides with of vegetative and reproduction phases.

Table 1. Stage wise crop water requirement and crop co-efficient for mung bean in *yala* season.

Stage	Length of growth stages (days)	Consumptive water requirement (mm)	Crop co-efficient
Initial	8	26.77	0.58
Crop development stage	22	74.74	1.0
Mid season stage	25	96.73	1.2
Late season stage	10	29.61	0.7

Table 2. Stage wise crop water requirement and crop co-efficient for mung bean in *maha* season.

Stage	Length of growth stages (days)	Consumptive water requirement (mm)	Crop co-efficient
Initial	11	34.3	0.47
Crop development stage	23	84.4	0.94
Mid season stage	24	122.3	1.3
Late season stage	10	29.1	0.8

Monthly  $K_c$  values calculated from this study were compared with the values suggested by the FAO. The FAO 56 paper (Allen *et al.*, 1998) has listed Mung bean  $K_c$  as 0.4, 0.75, 1.15 and 0.35 for the four growing stages. It can be noticed that the average  $K_c$  value observed in all four stages were higher than  $K_c$  value reported in the FAO 56 tabulated value.

### CONCLUSIONS

The total water requirement of Mung bean for whole growing period of *yala* and *maha* were estimated to be 270 mm and 228 mm. The crop coefficient values of Mungbean at initial, development, mid season and late season stages were found to be 0.5, 0.97, 1.25, and 0.75. These values markedly differ from the FAO standard values. Thus, to estimate the crop water requirement of Mung bean, the values determined under this study are recommended for Sri Lanka.

### REFERENCES

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