DETERMINATION OF CROP CO-EFFICIENT AND CROP WATER REQUIREMENT OF MUNGBEAN (*VIGNA RADITA* L.) IN DL1B AGRO ECOLOGICAL REGION OF SRI LANKA

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INTRODUCTION

Mungbean (*Vigna radita* L.) is becoming a very important pulse crop in the dry zone of Sri Lanka as it is used as a third season cultivation crop. Third season means Mungbean was cultivated after the paddy harvest using residual moisture in the paddy land with additional irrigation water. At present, farmers are opting for the production of this crop under irrigation due to changing pattern and uneven distribution of rainfall. However, the water requirement data and crop co-efficient of Mungbean crop is not locally available.

Crop co-efficient (Kc) values are required for estimating crop evapotranspiration (Hossain and Islam, 2010),.There was no specific co-efficient value for Mungbean so far in Sri Lanka. Even in literature such as Food and Agriculture Organization publications, crop coefficient values of green gram of 110 days duration have been used so far. But this particular research intends to introduce a new specific and accurate value for Mungbean crop in Sri Lanka which takes only 65 days to mature. Crop coefficient which is the ratio of crop evapotranspiration (ET_C) with treference to evapotranspiration, is an important parameter in irrigation planning and management (Allen *et al*.,1998). As the actual crop water requirement for local crops such as Mungbean is not known, the wastage of irrigation water is high. Physiological characteristics of crop varieties differ under different soil and climatic conditions, thus, showing varying physiological demands including crop water requirements. Hence, knowledge of experimentally determined Kc value is important for proper irrigation scheduling and efficient water management of the selected crop. In order to fulfill this, the study was designed for the determination of Mungbean ET and its crop coefficient (Kc). The results obtained will be useful for planning the supplemental or lifesaving irrigation. The objective of this research was to determine the crop coefficient for the different stages of the productive cycle of a Mungbean MI-6 variety, by using mini-lysimeter study results and weather data.

METHODOLOGY

Field experiments were conducted at the field of Grain Legumes and Oil Crops Research and Development Center (GLORDC), Angunukolapellessa during the period from November, 2012 to May, 2013. This research field is situated in the Southern dry zone of Sri Lanka. The research station belongs to the low country dry agro ecological region with reddish brown soil. Four sets of mini-lysimeters were assembled and used for this study to measure water balance parameters. Each set of mini-lysimeter consisted of a metal tank that had 0.3 meter square area and were 45 cm deep which served as the lysimeter tank and as non-weighing system where the crop was planted, with the drainage systems. Lysimeters were placed on the cement blocks and plastic bowls and buckets were kept under the lysimeter to collect the drainage. A polythene apron was used around the lysimeter to prevent rainwater splash as well as the overflow of water. The four lysimeters were irrigated with applied water or by natural rainfall. The drainage system consisted of a plastic bowl of 26 cm diameter and 18 cm deep which collects the drained water from the bottom of the lysimeter tank. The lysimeter tank was perforated at the bottom to allow drainage of water beyond what the soil can hold. Mungbean (variety: MI-6) was sown in four lysimeter tanks. Also, to maintain a similar environment, the same crop was grown in the lands surrounding

the tanks. Mungbean plant spacing was 30 × 15 cm based on Department of Agriculture recommendation. Fertilization was conducted and basal dressing was applied at the rate of 12 kgN/acre, 40kgP/acre and 30kgK/acre. As a top dressings 14kg/ac was applied to the Mungbean just after flowing. Chemical applications were conducted to control pest and diseases. (Imidacloprid20 S. L for control white flies, Thiophanate and Invelveuron tocontrol fungus and Thiamethoxam used for pests.)

The water balance data was collected and calculated daily in the growing period by applying the mass continuity equation and the evaporation was obtained by the difference between the soil water inputs and outputs (Equation 1).

$ETc = P - D - ES \pm \Delta A$ …… (1)

Where ETc is the crop evapotranspiration (mm), P the rainfall (mm), D the drainage (mm), ES the superficial runoff, and ΔA the soil water storage variation (mm).

Weather data for daily maximum and minimum temperatures, relative humidity, sunshine hours and wind speed were obtained from the Agricultural Meteorological Station Angunukolapellessa and Meteorological Department, Colombo and used to compute daily reference evapotranspiration (ETo) using the FAO-Penman Monteith model (Allen *et al*., 1998). The crop co-efficient was calculated using the following equation: (Burt *et al.,* 2005)

$ETc = K_C ETo$ …… (2)

Where K_C is the crop coefficient and ETo is the reference evapotranspiration and ETc is crop evapotranspiration.

RESULTS AND DISCUSSION

Reference evapotranspiration (ETo)

Many methods are available for estimating reference evapotranspiration (ETo). Reference evapotranspiration (ETo) was calculated on the basis of Penman (1948) for a given environment using local weather parameters (From November 26 – January 30). The software developed by FAO based on Penman Montieth namely CROPWAT model was used to estimate ET_0. Daily ETo was estimated using this setup .

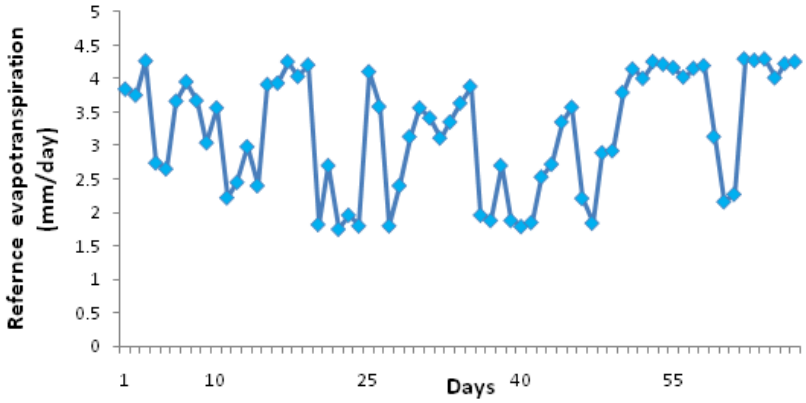

Figure 1 : Daily Reference evapotranspiration (ETo) of the Mungbean Crop (November 2012-January 2013)

Trends of reference evapotranspiration (observed within growing period) are presented in Figure 1.The difference in ETo is attributed to combined effects of temperature, sunshine hours, radiation, wind speed and relative humidity. The increased in ETo during the end of growing season can be explained by the change in weather because lowest rainfall and longest sunshine days were observed during this period.

Daily Crop Evapotranspiration (Daily Crop Water Use)

Figure 2 show the trend of the daily crop evapotranspiration of the Mungbean crop during the growing season. There was no definite pattern for the daily crop evapotranspiration of Mung bean with respect to crop age as the values kept rising and falling throughout the crop growing season. This is typical of daily evaporation during the rainy season as higher evaporation does happen on very sunny and cloudless days and lower evaporation on cloudy and rainy days.

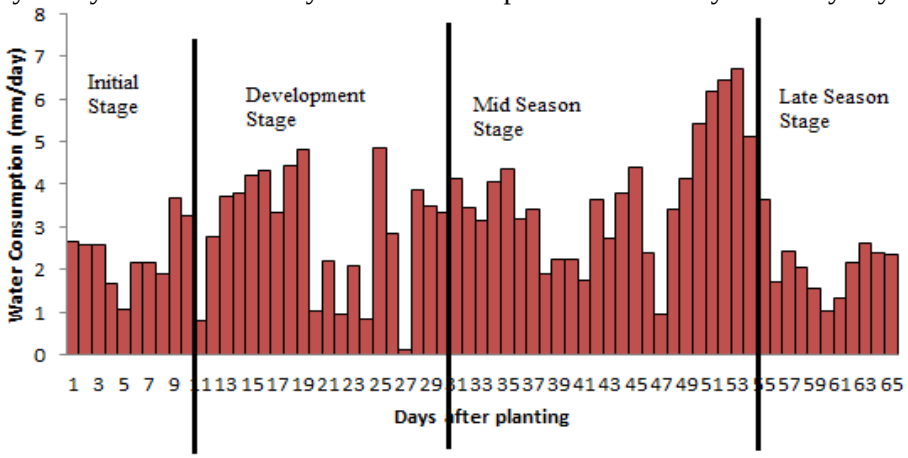

Figure 2 : Daily Crop Evapotranspiration of the Mungbean (November 2012- January 2013)

Crop co-efficient of the Mungbean

Values of the Mungbean crop coefficient, obtained in this study are presented in Figure 3. This figure shows that the Mungbean crop coefficient is not constant throughout its productive cycle.

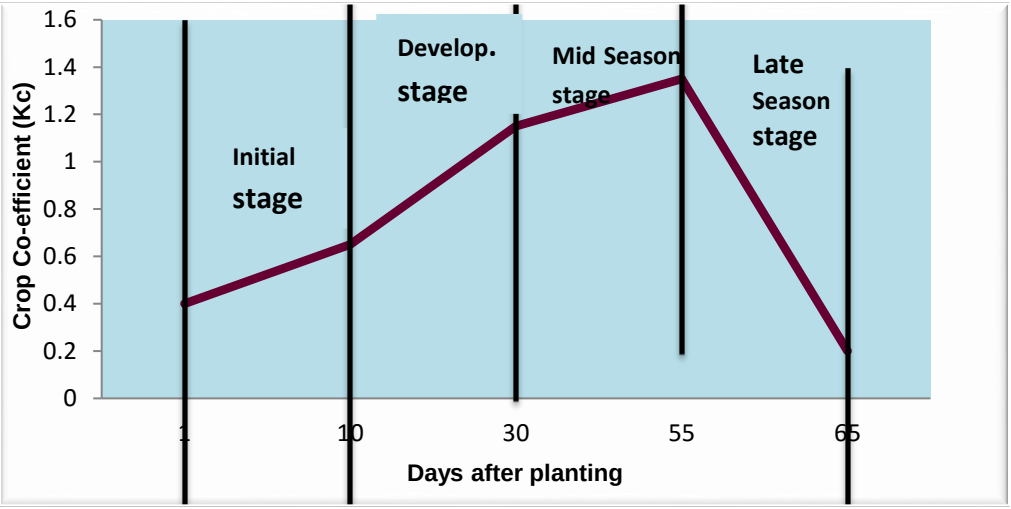

Figure 3: Crop coefficient (k_c) observed for Mungbean (November 2012- January 2013)

Stage	Length of growth Stages	Consumptive water requirement (mm)	Co-efficient value
Initial	8	16.77	0.58
Crop development stage	22	64.74	1.0
Mid-season stage	25	92.73	1.2
Late season stage	10	19.61	0.7

Table 1: Stage wise crop water requirement and co-efficient of Mungbean initial, development, Mid-season and late season growth periods

Water requirement were high for development and mid-season stage (64.74 and 92.73) and also crop coefficients were high for development and mid-season stage (1 and 1.2) respectively, because this was the period when the crop completed vegetative phase and flowering

CONCLUSIONS

The Mungbean evapotranspiration obtained by the soil water balance method, increased from 16.77 mm in the months of November and December at initial stage to 64.74 mm in December month at the development stage then it increased to 92.73 mm in December and January months at the mid- season stage after it declined to reach the values of evapotranspiration 19.61 mm in January month at the late-season.

Total water requirements of Mungbean for whole growing period were 193.8 mm.

The crop co-efficient values of MI-6 Mungbean at initial, development, mid-season and late season stages were found to be 0.5, 1, 1.2 and 0.7, respectively from the lysimeter study. These values differed from the standard values to some extent (Doorenbos and Pruitt, 1977), Therefore the calculated crop water use and crop coefficients will help to reduce the irrigation water as at present more than 4 times of water is used for MI-6 Mungbean crop. These results were taken from one season data therefore the study will be continued to confirm the results.

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