Radiation Use Efficiency Calculator

This is the software developed using Microsoft Access with Visual Basic Script.

Radiation use efficiency (RUE) is important in understanding and modeling the relationship between plant growth and the physical environment. Crop growth can be described as the product of the incident Photo synthetically Active Radiation (PAR); the fraction (f) of PAR intercepted by green leaf (*f*); and the 'efficiency' with which the PAR is used as Radiation Use Efficiency (RUE). PAR depends on the location and time of year while seasonal *fraction (f)* is affected by the duration and the area of the canopy. Radiation Use Efficiency (RUE) is defined as the ratio of dry matter produced to absorbed photosynthetically active radiation (APAR). It is usually measured in grams of dry matter per mega joule (g DM MJ-1).

Daily sunshine hours(sh) for different locations were collected and daily total radiation (RDD kJ m^{-2} d^{-1}) was computed by using the Angstrom formula derived from Oryza2000 model (Bouman, 2001)

RDD= S_0*(a_A+b_A*(sh/day length)

S_0 is the theoretical amount of global radiation without an atmosphere (kJ m^{-2} d^{-1})

a_A and b_A are an empirical constants Angstrom A & B parameters.

Shortwave radiation was calculated by the product of daily total radiation with the ratio of actual effective sine of solar inclination (SinB) over the integral of effective SINB (DSINBE). Fraction of PAR was calculated from the fraction of diffused radiation which is calculated from the atmospheric transmission. This radiation flux at Earth's surface, assuming 100% atmospheric transmission, was calculated from the solar constant, which is the radiation flux perpendicular to the sun rays, multiplied by the sine of the solar inclination (SinB), which changes during the day.

Short wave radiation (TMPR1) =RDD*SINB*(1.0+0.4*SINB)/DSINBE

PAR =TMPR1*fraction of PAR (0.5)

Absorbed PAR=PAR*40%

From this data,APAR (MJ/m^2) for different phenological stages, Panicle Initiation (PI), PI to maturity and maturity period, was calculated. RUE was calculated by the following equations.

RUE_{PI} = TDM at PI/∑APAR from sowing day to PI day

$RUE_{PI\ to\ Mat}$ = TDM at PI/∑APAR from PI to maturity

RUE_{Mat} = TDM at PI/∑APAR from sowing day to maturity

Where ΔTDM_t = Total above ground dry matter accumulated for the specific period (g/m^2).

$\sum APAR_t$ = PAR which is absorbed for the specific period (MJ/m^2)

A analytical software program has been developed to facilitate estimation of RUE quickly and accurately using Microsoft Access with Visual basic code and evaluated for 6 years. The software was designed to compute genotype wise radiation use efficiency for different locations spread across India. Rice genotypes were assessed for efficient biomass production and yield at different stages of rice crop.

Six tables, seven forms and five queries were designed for computing radiation use efficiency across locations at different stages. Location details, sowing details, RUE trial details and sowing date wise sunshine hours will be entered using the specific user friendly forms. User has to enter minimum input parameters and easily compare the radiation use efficiency across locations at different stages of rice crop. The data generated by queries can be easily copied to excel and use for further analysis with other data sets.

This software was evaluated with six years data of Radiation Use Efficiency experiment conducted under All India Coordinated Rice Improvement Programme (AICRIP). RUE software was designed according to the requirement of RUE Experiment conducted at different locations under AICRIP. This software is easily understandable and user friendly. This can be customized easily as per the requirement of any experimental design of rice crop for computing genotype wise radiation use efficiency.

Further this software will be upgraded to web based software to reach to more users.