

A Web based Photothermic Indexing Calculator for Rice Genotypes

Plants require a certain amount of heat to develop from one point in their life cycles to another. This measure of accumulated heat is known as physiological time. Physiological time is often expressed and approximated in units called degree days (D). The development rate over time is expressed in daily heat units/degree days(°C d). All plants tend to respond to the seasonal and daily variation in the duration of night and day time periods. Plant responses to this variation were attributed to the variation in the day time duration(Photoperiod) rather than to its complementary part of dark time duration (Nyctoperiod). Rice has been classified as a quantitative short day plant. In other words, it is a long night requiring plant. Hence nyctoperiods are also considered.

Heat Units/Degree Days(°C d) : The growth and development of both plants and insects is strongly dependent on temperature. Below the base temperature (Td) and above the maximum temperature (Tm) the rate of development is zero. Three cardinal temperatures base temperature, optimum temperature(To) and maximum temperatures are identified to compute the heat units. The development rate over time is expressed in daily heat units/degree days(°C d) . Daily heat units were calculated using the following formula

$$HU = \sum_{h=1}^{24} (HUH)$$

where h is time of the day. Hourly increments in Heat Units (HUH) are calculated if $T_d \leq T_b$ and $T_d \geq T_h$ then $HUH=0$

if $T_b < T_d$ and $T_d \leq T_o$ then $HUH=(T_d-T_b)/24$

if $T_o < T_d$ and $T_d < T_h$ then

$$HUH = [T_{opt} - (T_d - T_{opt}) \times (T_{opt} - T_{base}) / (T_{high} - T_{opt})] / 24$$

Daylength (Photoperiod in hours): These calculations involve some empirical relationships that calculate the day length and integral of the sine of the solar angle from the day number and latitude. Nyctoperiod is calculated by subtracting the photoperiod from 24.(total no. of hours /day).

Manual process of computing day wise values is tedious and time consuming. Hence, Photothermic Indexing (PTI) software has been developed to compute day wise heat units, photoperiod and nyctoperiod and genotype wise cumulative photoperiod and nyctoperiod at different stages of Rice crop.

PTI software has 3 tabs for Home, Compute PTI and Contact details. Home page has login form with brief introduction about computation of PTI. User registration is mandatory for using the computation facility of PTI. Compute PTI tab has 3 menu items such as Heat Units/Degree Days, Day Length/Photoperiod and Nyctoperiod, Experimental data- Photoperiod and Nyctoperiod.

PHOTO THERMIC INDEXING
 [COMPUTING PHOTO PERIOD AND NYCTO PERIOD]

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Please enter your username and password. Register: [You can create an account](#)

PHOTO THERMIC INDEXING

Plants require a certain amount of heat to develop from one point in their life cycle to another. This measure of accumulated heat is known as physiological time. Physiological time is often expressed and accumulated in units called degree days (DD). Heat units are equal to the amount and daily variation in the heat energy and day length (or vice versa). Heat response by the system were obtained by the variation in the day (or night) length period) after time is to be experimentally set of time duration (development). Also has been classified as a quantitative error day plant. In other words, it is a long night resulting plant leaves hypertrophy are also considered.



Heat Units/Degree Days (HDD)

The growth and development of heat plants and insects is strongly dependent on temperature. When the temperature is above the minimum temperature, the rate of development is linear. These values represent the base temperature (minimum temperature) and optimal temperature are identified to compute the heat units. The cumulative heat unit days is increased in daily base units, degree days (DD).

Heat units are calculated using the following formula:

$$HDD = \sum_{i=1}^n (T_{i,avg} - T_{min})$$

where $T_{i,avg}$ is the daily average temperature (HDD) and T_{min} is the minimum temperature. $T_{i,avg} = (T_{max} + T_{min}) / 2$
 $T_{i,avg} = (T_{max} + T_{min}) / 2$
 If $T_{max} < T_{min}$ and $T_{min} < T_{opt}$, then:
 $HDD = (T_{max} - T_{min}) / 2 * (T_{max} - T_{min}) / 2$

Detailed Information is available

These calculations involve some empirical relationships that calculate the day length and integral of the sine of the cosine angle from the day number etc. latitude (longitude) is calculated by subtracting the geocentric from 20-degree (or 10-degree) etc.

Heat Units/Degree days

This menu prompts for location, start date and end date and minimum and maximum temperatures for computing degree days. In addition to this, there is "Copy from Excel check box" to copy temperatures from excel to the interface and by clicking the "Click here to copy data to the grid" the data will be copied to the grid. By using 'Calculate Result' Heat degrees will be computed and displayed in the grid. This data can be copied easily to Excel or Word.

(COMPUTING PHOTO PERIOD AND NYCTO PERIOD)

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HEAT UNITS / DEGREE DAYS

Location:
 add your Location and Latitude

Start Date:
 End Date:
 T base:
 T opt:
 T High:

Cardinal Temperatures for Rice (Gao et al 1992)

Base temperature(Tbase, 0C) = 8

Optimum Temperature(Topt , 0C) = 30

Maximum Temperature(Thigh , 0C)= 42

enter temperatures in degree celsius

Copy from Here!

S.No.	Date	TMIN	TMAX
1	12-6-2019	19	28
2	13-6-2019	24	30
3	14-6-2019	20	32
4	15-6-2019	18	25

[Source & Reference](#)

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S.No	Date	Tmin	Tmax	tot hu	cum hu
1	12-6-2019	19	28	16.0	16.0
2	13-6-2019	24	30	10	26.5
3	14-6-2019	20	32	15.00	53.00
4	15-6-2019	18	25	15.5	69.55

[Here all Temperature's are in degree celsius (0C)]

[Source & Reference](#)

Daylength (Photoperiod in hours)

This menu prompts for location, start date and end date and computes photoperiod and nyctoperiod for the input dates. By using the submit button Julian date, photoperiod and nyctoperiod will be calculated and displayed in the grid. This data can be copied easily to Excel or Word.

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(COMPUTING PHOTO PERIOD AND NYCTO PERIOD)

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DECLINATION OF SUN SHINE

Location: Papua ▼

Add your Location and Latitude

Start Date: 07/05/2019

End Date: 17/05/2019

S.No	Selected Date	Julian Day value	Cumulative DD	Cumulative Nycto Period
1	07-5-2019	70	11,9515	10,048
2	08-5-2019	71	11,9616	11,965
3	09-5-2019	72	11,9717	13,882
4	10-5-2019	73	11,9818	15,799
5	11-5-2019	74	11,9919	17,716
6	12-5-2019	75	12,0020	19,633
7	13-5-2019	76	12,0121	21,550
8	14-5-2019	77	12,0222	23,467
9	15-5-2019	78	12,0323	25,384
10	16-5-2019	79	12,0424	27,301
11	17-5-2019	80	12,0525	29,218

[Source & Details](#)

Experimental data- Photoperiod and Nyctoperiod

Experimental data interface has two forms; One form prompts for sowing date, sowings, number of replications and varieties. There are two check boxes for opting the crop growing stages like Panicle Initiation and Flowering. Second form generates grid for the above sowings, replications and varieties. The data can be copied from excel using 'Copy from Excel' check box and by clicking the "Click here to copy data to the grid" the data will be copied to the grid. The by using "Add PTI details", the data will added to the PTI database and computes grid wise photoperiod and nyctoperiod at different stages of rice crop. The values will be displayed in the grid. The data generated by this software can be easily copied to excel and use for further nalysis with other data sets.

PTI USING EXPERIMENTAL DATA

Location:

add your Location and Latitude

Sowing stage Level:

Sowing Date for Level:

Number of Replications:

Number of Varieties:

Stage: days PI panicle initiation days FI Towing in

09	78	120
55	80	125
175	77	126
23	85	120

[click here to copy data to the form below](#)

Location	PTI Year	Sowing Level	Replication	Variety	Days_PI	Days_FL	Days_MAT
IRR	2020	1	1	1	<input type="text" value="31"/>	<input type="text" value="91"/>	<input type="text" value="120"/>
IRR	2020	1	1	2	<input type="text" value="34"/>	<input type="text" value="80"/>	<input type="text" value="124"/>
IRR	2020	1	2	1	<input type="text" value="24"/>	<input type="text" value="77"/>	<input type="text" value="124"/>
IRR	2020	1	2	2	<input type="text" value="23"/>	<input type="text" value="85"/>	<input type="text" value="123"/>

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PTI - EXPERIMENTAL DATA

S.No	Level	Replication	Variety	DD_PI	Nycto_Period_PI	DD_FL	Nycto_Period_FL	DD_MAT	Nycto_Period_MAT
1	1	1	1	155.8	252.1	676.24	801.78	2226.17	1757.87
2	1	2	1	420.42	450.58	1006.07	1029.96	2510.5	1409.5
3	1	1	2	604.75	255.24	902.36	825.84	1620.61	1442.99
4	1	2	2	250.01	271.99	811.59	748.41	1564.78	1387.22

This software was evaluated with five years data of photothermic indexing experiment conducted under All India Coordinated Rice Improvement Programme (AICRIP). This software is easily understandable and user friendly. As this program uses solar declination and latitude to compute photoperiod and nyctoperiod, the software can be used for other crops also. This can be easily customized any other experimental designs.