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Short Comminucation

Heat unit requirements of different rice genotypes at Coimbatore

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Rice (*Oryza sativa* L.) is the most important cereal food crop in the world. It is consumed by about 3 billion people and is the most common staple food of a large number of people than any other crop on earth. Rice productivity is highly dependent upon prevailing weather conditions. Some of the weather parameters like sunshine hours, day length (photoperiod), temperature and rainfall are important natural resources which affect the rice productivity to a great erextent. The optimum utilization of these resources can also vary among different rice cultivars. Crop duration interactively determined by the genotype and the environment (Vergara, 1976). Thermal and photoperiodic conditions significantly affect the vegetative and reproductive development of the crop. Variations in thermal conditions are crucial for three main reasons. Firstly, vegetative growth occurs during a period of suitable temperature and maximum levels of solar radiation. Secondly, it ensures the cold sensitive stage when the minimum night temperatures are historically the warmest. Thirdly, it assures that grain filling happens when milder autumn temperatures are more likely, hence good quality of grain is obtained. The only choice for rice grower to escape the climatic shortfalls is from suitable rice cultivars and adjustment of sowing and transplanting dates (Dingkuhn *et al*., 1995).Temperature based heat units will be the basic principles to understand the phenology and follow the proper sowing times for different crop varieties over the spatial and temporal variations (Sreenivas *et al*., 2010).

Sowing time and selection of variety may play the deciding role in performance of rice, hence choice of correct variety and selection of right time for sowing and transplanting under particular agroclimatic condition call for success of rice production under changing climatic scenario. Hence the proposed study was under taken to study the phenology on heat unit of rice genotypes sown at different dates.

The field experiment was carried out during the *kharif season* of 2014 at Department of Rice Tamil Nadu Agricultural University, Coimbatore. The experimental location is geographically situated in western agro-climatic zone of Tamil Nadu at11ÚN latitude and 77ÚE longitude with an altitude of 426.72 m above Mean Sea Level. The weather conditions prevailed during the entire cropping period was collected from meteorological observatory (Davis Vantage Pro2 wireless weather station), Department of Rice, Tamil Nadu Agricultural University, Coimbatore.The experiment was laid out in a split plot design having three replications and three sowing datesas main plots and twelve rice genotypes as sub plots having different maturity duration respectively. Sowing was done as three different sowing dates *viz.,* 9th June, 23rd June and 7thJuly. Twenty days old seedlings were transplanted manually in the main field. The early sown crop was transplanted on 26th June, for mid sown crop 11th July and the late sown crop 25th July. The dates of occurrences of different crop phenological events like active tillering, panicle initiation, 50 per cent flowering, grain filling and physiological maturity were recorded.

The heat unit or growing degree days (GDD) was worked out as proposed by Nuttonson(1955). Heat Units or (GDD) expressed in (°C day).

$$GDD = \frac{\Sigma(Tmax+Tmin)}{2} - \text{Base temperature}$$

Where,

T_{max} - Daily maximum temperature (°C)

T_{min} - Daily minimum temperature (°C)

Base temperature of rice -10° C

The data collected were subjected to statistical analysis in split plot design (Gomez and Gomez, 1984).

Phenology

The variation in length of different phases and stages in the life cycle of twelve rice genotypes under different sowing windows are given in (Table 1). Among the different sowing dates, rice genotypes sown on June 9threquired longest period to reach all phenological phases *viz*., active tillering (36 days), panicle initiation (74 days), 50 % flowering (99 days), grain filling (106 days) and physiological maturity

Table 1: Effect of sowing windows on different phenological stages and heat units of rice genotypes

Treatments	Phenology					Heat Units				
	Active Tillering	Panicle Initiation	50 % Flowering	Grain Filling	Physiological Maturity	Active Tillering	Panicle Initiation	50 % Flowering	Grain Filling	Physiological Maturity
Sowing windows										
June 9th	36	74	99	106	130	960	1885	2544	2753	3337
June 23rd	35	72	97	106	128	910	1872	2527	2735	3315
July 7th	35	70	96	105	125	898	1859	2511	2710	3283
Genotypes										
IET 20924	38	75	99	107	130	986	1948	2578	2787	3366
IET 22569	35	75	99	107	130	917	1931	2561	2771	3357
IET 22580	36	73	97	105	129	934	1880	2523	2727	3348
IET 23275	36	73	101	108	134	928	1897	2612	2813	3457
IET 23299	34	77	93	102	124	893	2000	2420	2630	3203
IET 23324	34	70	96	104	126	886	1818	2491	2683	3270
MTU 1010	34	66	88	98	121	894	1708	2283	2490	3125
CB-08-504	34	71	96	104	129	894	1839	2481	2689	3339
CB-08-513	34	72	93	101	124	876	1804	2411	2619	3212
CB-06-123	40	78	105	114	136	1039	2029	2730	2949	3511
CB-05-022	40	81	114	122	138	1038	2107	2952	3156	3563
CO (R) 51	30	58	88	96	115	790	1503	2281	2481	2985

(130 days). Among the twelve rice genotypes, the long duration genotypes CB-05-022 required longest period (40 days) to attain active tillering stage, 114 days to attain 50% flowering stage and 138 days to attain physiological maturity stage followed by CB-06-123. Since, these two genotypes are long duration genotypes which require longest duration of vegetative phase. It is noted that early sown crop experienced optimum temperature as compared to delayed sowing i.e. July 7th in all genotypes. With delay in sowing, the crop duration was drastically reduced on account of shorter vegetative and reproductive phase. Flowering duration is an important character that is frequently considered before release of a variety for commercial cultivation. In current study, the time interval between sowing to 50 per cent flowering stage of the rice genotypes ranges from 88-114 days (Table 1).The genotype CB-05-022 which sown on June 9th required 114 days to reach 50 per cent flowering stage which the duration was getting shorten consequently under delayed sowing of the same rice genotypes proofed that there was an effect of different sowing windows and environmental conditions on crops sown at three sowing dates. The increased flowering duration in early sowing June 9th was due to optimum temperature and solar radiation which prisoner flowering process. These findings are also in line with report of De Datta (1981). For grain filling and physiological maturity stages also the same trend was followed. Duration of phenophases was reduced with delayed sowing i.e. July 7th which requires lesser number of days to reach all the phenophases (Table 1).Similar results were in line with the findings of Raissc *et al.* (2004).This reduction in duration of rice genotypes under late sowing July 7th was because of forced maturity and unfavourable environmental conditions like high temperature, rainfall during flowering phase, cloudy weather, changes in temperature above or below the optimum temperature at reproductive stage.

Heat units

Heat units are involved in several physiological processes like specific amount of heat units required for the plant at each stage from its germination to harvest of the crop would vary and the important processes are growth and development, metabolism, biomass, physiological maturity and yield.Every crop needs a specific amount of heat units to enter its reproductive phase from vegetative phase. In case of our study, maximum heat units was accumulated when the rice genotypes were sown on June 9th (Early sowing) than Mid sowing (June 23rd) and Late sowing (July 7th) for all the crop growth stages *viz.*, Active tillering (960ÚC day), Panicle initiation (1885 °C day), 50% flowering (2544 °C day), Grain filling (2753 °C day) and Physiological maturity(3337 °C day) which the heat unit accumulation was lesser when the rice genotypes sown on June 23rd and July 7th because of the reduction in duration of each phenophases (Table.1). While in late sown (July 7th) crop experienced higher temperature during later stage in less time.The heat units accumulated by other sowing dates were lower by 9.6%, 2.1% than that accumulated by sowing on June 9th. Both the maximum and minimum temperature varied widely in three sowing dates of investigation. This led to reduction in duration of growth phases as well as heat units requirement under late sowing i.e. July 7th. Optimum temperature during the earlier period leads to increase in duration of different phenophases which ultimately increased the heat units of the rice genotypes sown on June 9th. The deficit heat units at the time of flowering leads to early flowering. The excess heat units accumulation at flowering causes delayed flowering. In rice where the temperature drops from 24°C to 21°C a sharp decrease in days to flowering occur. A temperature drop by 1ÚC leads to 13 days delay in heading. When the temperature increases above 24°C, days to flowering decrease to 91 days at 27°C and to 86 days at 30°C. A temperature raise of 1°C above 24°C shortens the number of days to flowering by less than 2 days (Parthasarathi *et al.*, 2013). The earlier sown June 9th rice genotypes accumulated more heat unit as compared to late sowing July 7th particularly in the case of genotype (CB-05-022) 3563°C days was observed at the stage of physiological maturity. These provide very clear picture of the amount, pattern and efficiency of heat energy consumption at different phenological stages of the rice.

The present findings concluded that heat units were recorded maximum in rice genotypes sown on June 9th as compared to on June 23rd and July 7th sown. Genotypes with longer crop duration *viz.,* CB-05-022, CB-06-123, IET 20924 and IET 23275 may be suitable choice for optimum yield under projected changing climatic scenario. Thus, it utilizes the heat energy sufficient for its growth and development in an effective manner with longer vegetative growth phase. Selecting a desirable sowing date and using suitable rice cultivars for different agro climatic conditionsare specifically important in order to provide sufficient time for input residue distribution, yield improvement and prevention from climate damage.

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