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Short Communication

On some observed pheno-meteorological features of the rice crop

D. RAJI REDDY[*], S. VENKATARAMAN[+], G. SREENIVAS,[*] S.B.S.N. RAO,.[*] and K. LALITHA[#]

* Agromet Cell, Agricultural Research Institute, Rajendranagar, Hyderabad, 500030

+ Author for Correspondence: 59/19, Nav Sahyadri Society, Pune, 411052.

Department of Agriculture, Govt. of Andhra Pradesh, Hyderabad.

The drymatter accumulated at heading, which is directly proportional to the quantum of intercepted solar radiation, ISR, by the crop canopy, has a significant influence on grain yield of rice (Rao et al, 1999). ISR is a function of the duration of the vegetative phase of the crop and the time between the attainment of optimal leaf area index of 4.0 for photosynthesis (Murata, 1967) and heading of the crop. The former is governed by tiller population and rate of tiller formation, both of which are affected by temperature. In rice differences in duration of cultivars are mainly due to differences in the duration of the vegetative phase (Oldeman et al, 1987). Thus, duration of the vegetative phase and time of attainment of maximal tillering emerge as important yield-determining factors in rice. Meteorological assessment of the above two is complicated by the practice of transplanting, in which the emphasis is on age of seedlings and not its attribute in terms of degree-days. Again, due to transplantation shock phenological development especially commencement of tillering is delayed to the extent of 30% of the age of the seedlings.

In light of the above, the phenological and phenometric data on rice presented by Lalitha et al. (1999, 2000) and Reddy et al (2004) were agrometeorologically examined, as detailed below, to understand the pheno-meteorological relations of rice.

Data of Lalitha et al, (2000) show that the duration of tillering covering 6 sowing dates in Kharif and 3 sowing dates in Rabi is 55 days at a temperature of 23° C, 48days at 24°C and 35 days at 26.5°C. The observed durations are reconcilable by degree-day summation of 375 above a base temperature of 16°C. Spikelet number at heading is an yield- influencing factor (Kudo, 1975) and is determined by tiller density. For the above sowing dates Lalitha et al (1999) have also provided data on tiller population for 3 rice cultivars. It is seen that the average tiller production per day of the 3 cultivars are 8.5 at 23° C, 11.0 at 24° C, 14.0 at 26.0° C, 15 at 26.5° C and 18.5 at 27.0° C. The sharp increase in rate of tillering beyond 26.5°C is striking. From the above it is seen that tiller production per m^2 will be 467 at 23.0° C, 525 at 26.5° C and 650 at 27.0°C.

The contention (Owen, 1972) that the lower rate of production of tillers at low temperatures will be more than

Table 1: GDDs and days required for completion of 3 main rice crop phases. (After Raji Reddy, et al. 2004).

	Phase I			Phase II			Phase III		
	Days	GDD	%	Days	GDD	%	Days	GDD	%
K V1	67	1074	56	23	388	20	29	450	24
R V1	94	1128	52	25	436	20	29	590	27
K V 2	90	1470	65	25	428	19	28	381	17
R V3	96	1163	54	23	415	19	28	577	27

Legend : K- Kharif; R- Rabi; V- Variety; GDD- Growing Degreed days > 10° C; Phase I- Sowing to Panicle Initiation. Phased II- PI to 50% Flowering; Phase III- 50 % Flowering to Maturity; %- fraction of Total GDD in the Phase.

compensated by the increased duration of lering is seen to be not valid. Optimal nperatures for tillering may not mostly be realized in rice culture. The effect of sub-optimal temperatures on reduced tiller population and hence of lesser spikelet number and lesser cumulated leaf-area and hence of lesser ISR can be countered by suitably increasing the initial population density of the crop (Venkataraman,2004). However, during *rabi* season the longer vegetative duration will push the maturity period of the crop into a warmer weather regime and negate the gains of increased ISR due to thicker sowings.

Reddy et al (2004) have presented data on phenological and growing degree-days, GDDs above a base temperature of 10°C for the 3 crop phases of (i) Sowing to Panicle Initiation, PI (ii) PI to 50% Flowering and (iii) 50% flowering to Maturity for 3 cultivars sown on 3 dates in the Kharif and Rabi season for 2 years. Their work makes available above data for (a) the same cultivar sown in Kharif and Rabi season (b) two different cultivars sown in Kharif season and (c) two different cultivars sown in Rabi season. The data presented by them are summarized in Table 1, in which the values of the parameters refer to average values of 6 dates of sowing due to little variation in them in various dates of sowing.

Some interesting features emerging from the Table 1 are presented below.

The duration from sowing to PI of Variety, V1, Tellahamsa was 67 and 94 in Kharif and Rabi seasons respectively. But the GDD in both the season was 1101 plus or minus 27. Variety IR 64, V3, had a duration of 9 days from sowing to PI with a GDD of 1163. However, Variety Sambha Masuri, V2, a long duration variety, had a duration of 90 days from sowing to PI and a GDD of 1470 plus or minus 167. It is not suited for Rabi cropping and in areas with shorter rainy season.

For all dates of sowing in Kharif and Rabi season for the 3 varieties, the duration and GDD from PI to 50% flowering was about 24 plus or minus 5 days and 412 plus or minus 24 respectively. However, while the duration from 50% flowering to maturity was 28 days plus or minus 4 days in both Kharif and Rabi season the GDDs were 415 plus or minus 35 in the Kharif season and 580 plus or minus 10 in Rabi season. The 50% Flowering to maturity period was 2°C higher in the Rabi season compared to the Kharif one and can at best account for a difference of 60 GDDs. The higher GDD for the third phase in the Rabi season needs a critical examination.

Varieties V1 and V3 showed reduction in field-life durations with delay in sowings in the Rabi season. However, the GDD for the crop life remained the same at 2150 plus or minus 100. This indicates that the GDD requirements of the cultivars are namely conservative and the delayed sowings by pushing the crop into warmer weather in the later part of its life curtailed its field-life.

The phasic percentage distribution of the total GDD show that for all varieties in both Kharif and Rabi, phase II accounts for 20% of GDD. For the two short duration cultivars, both in Rabi and Kharif the distribution is 54% in phase I and 26% in Phase III. For longer duration variety the increased percentage in phase I is compensated by an equivalent decrease in phase III. Thus one can hazard a guess that for rice varieties of same duration the phasic distribution of total GDDs will also be the same, though more data on the cultivars needs to be examined specially on the longer vegetative duration of KV2.

The study shows that even limited phenological data on rice recorded randomly across locations, seasons and varieties when expressed and interpreted in terms of GDD can help in (i) extrapolation of the findings in time and space by temperature links and (ii) gauging the phasic GDD requirements of different cultivars.

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