Journal of Agrometeorology 15 (2) : 167-169 (December 2013)

Short communication

Thermal requirement of r*abi* maize in North Coastal Zone of Andhra Pradesh*

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A range of climatic factors affect the crop growth and development. Temperature is the most important among all environmental factors that influences rate of plant growth. Grain yield of corn differs considerably across the growing areas even when soil fertility and moisture supply are near optimal. Reasons for such variation might be differences in sun shine hours or temperature etc. Temperature influences both timing and duration of the each phenophase. The effect of temperature on the length of plant growth cycle, especially the grain filling phase is the most important factor in explaining the reduced yields at warmer temperatures (White and Reynolds, 2003).

The occurrence of different phenological events during crop growth period in relation to temperature can be estimated by using accumulated heat units or growing degree days (GDD). Knowledge of accumulated growing degree days can provide an estimate of harvest date as well as crop development stage (Ketring and Wheless, 1989). Heat units required for maize crop to progress from one phase to other phase has been reported earlier by Thavaprakash *et al.*, (2007) and Girijesh *et al.*, (2011). So a field experiment was conducted to study the thermal requirement of *rabi* maize in North Coastal Zone of Andhra Pradesh for ultimate planning of crop for optimized yield.

Field investigation was carried out during *rabi* season (October - April) 2011-12 at Regional Agricultural Research Station, Anakapalle. The farm is located at an altitude of 28.62 m above mean sea level at 17°38' N latitude and 18°01' E longitude. Daily meteorological data during crop growth period was recorded in class B observatory situated at Regional Agricultural Research Station, Anakapalle.

Soil of the experimental field was sandy loam in texture, low in available nitrogen (236 kg ha^{-1}), medium in phosphorus (40.4 kg ha^{-1}) and high in available potassium (300 kg ha^{-1}). The experiment was laid out in split-split plot design with six dates of sowing at fort nightly interval commencing from 15th October. Sowing dates were taken as main plots, two spacings as sub plots and three nitrogen levels as sub - sub plots thus constituting 36 treatment combinations replicated three times. KH-9374 maize hybrid was sown as per the treatments and all recommended package of practices were followed. Crop protection measures were taken up against pests and disease infestation. Crop weather relations were worked out at recommended spacing and nitrogen level so as to keep the weather as the only variable in crop growth and development. Irrigations were scheduled as and when required. Crop did not suffer due to moisture stress at any stage. The dates of occurrence of silking and maturity were recorded. Grain yield was recorded after harvesting and shelling and the data was statistically analyzed.

Helio thermal units (HTU) were calculated using the formula given by Rajput (1980).

HTU = "GDD x Cumulative sun shine hours

Phenothermal Index (PTI) was calculated as

PTI = Degree days consumed between two phenological stages

No. of days between two phenological stages

Rate of seedling emergence

Mean temperature had considerable influence on seedling emergence. Rate of seedling emergence increased from 0.08 to 0.13 per day with increase in daily mean temperature from 22.9^{o} C to 26.6^{o} C. Rate of seedling emergence was maximum at 26.6^{o}C and attained 50 per cent emergence within 8 days as against 15 days at daily mean temperature of 21 ^{o}C (Fig.1). Correlation studies indicated that increase in daily mean temperature significantly increased the seedling emergence (r=0.9). Sharma *et al.*,

* Paper presented in national seminar on "Climate change and Indian Agriculture : Slicing down the Uncertainty" held at CRIDA, Hyderabad during 22-23 January-2013 and reviewed for special issue of the Journal.

Table. 1: Yield response of maize to phenothermal index, growing degree days and heliothermal units in different dates of sowing

Dates of sowing	Germination to Silking		Silking to Maturity		Pheno-thermal index		GDD	HTU	Grain Yield (kg ha^{-1})
	Duration (day)	Mean temp.(°C)	Duration (day)	Mean temp. (°C)	Germination to Silking	Silking to Maturity			
Second FN of October (D1)	42	25.0	57	22.1	15.0	12.1	1317	9087	5722
First FN of November (D2)	49	23.7	59	21.9	13.7	11.9	1372	9604	5945
Second FN of November (D3)	50	22.1	52	23.5	12.1	13.5	1306	9077	5801
First FN of December (D4)	53	21.5	49	24.4	11.5	14.4	1316	9107	4674
Second FN of December (D5)	51	21.7	46	25.3	11.7	15.3	1300	9230	4978
First FN of January (D6)	51	22.0	42	27.0	12.0	17.1	1330	9709	5081
SEm+							16.0	35.0	105.3
C.D(P=0.05)							64.0	107.0	332.0

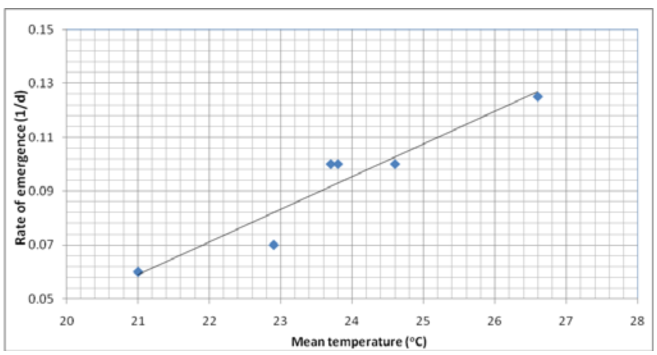

Fig.1: Relationship between daily mean temperature and rate of emergence(Er)

(1989) noted that food reserves (carbohydrates, proteins and lipids) present in seed exhausted with advancement of germination but under low temperature this process occurred at lower rate, hence less rate of development.

Growing degree days (GDD)

Growing degree days required from germination to physiological maturity during *rabi*, 2011 have been shown in Table 1. Maize crop sown during first fortnight of November consumed the maximum heat units of 1372 degree days. With delay in sowing from first fortnight of November to first fortnight of January, degree days consumption were decreased. However the crop matured on accumulating 1324 + 48 degree days regardless of sowing date. As the growing degree days are calculated based on the temperature, the duration of crop is decided by the prevailing mean temperature (Bell and Wright, 1998).

Helio thermal units (HTU)

Heliothermal units required for maize crop growth period sown for different dates of sowing have been shown in Table 2. Heliothermal units in different dates of sowing ranged between 9087 to 9709. Maize crop sown during first fortnight of January (D6) recorded higher heliothermal units as the crop was exposed cloud free situation with more number of sunshine hours coupled with dry weather during later part of the growth period. Higher Heliothermal units under delayed sowing of maize crop was also observed by Girijesh *et al.*, (2011). However, early sown crop during first fortnight of November also recorded higher HTU due to comparatively higher number of growing degree days coupled with more number of sunshine hours than other dates of sowing.

Pheno termal index (PTI)

The phenothermal index for consecutive phenophases was computed and presented in Table 3. The mean phenothermal index increased with delay in sowing during silking to maturity phase. The crop sown during first fort night of January recorded higher Phenothermal Index (14.6) as compared to crop sown during other dates.

Yield (kg ha^{-1})

Significantly highest grain yield was recorded in crop sown during first fortnight of November followed by second fortnight of November. Crop sown before November, during December and January recorded relatively lesser grain yield of maize. The results indicated that maize crop sown during November experienced congenial weather conditions particularly mean temperature than early or late sown maize crop during *rabi* in North Coastal Zone of Andhra Pradesh. Among all dates of sowing, crop sown during first fortnight of November availed higher number of growing degree days and heliothermal units and there by higher grain yield (5945 kg ha^{-1}). The present study indicated that application of agro-meterological indices can help in planning of crops in a scientific way as they can precisely define the relationship with different crop phenophases. The agro-meterological indices can also be used very effectively for forecasting the occurrence of different phenophases of the crops.

REFERENCES

Bell, M. J. and Wright, G. C. (1998). Groundnut growth and development in contrasting environments 2. Heat unit accumulation and photothermal etteets on harvest index. *Expl. Agric*., 34 (1): 113-124.

Girihesh, G. K, Kumara Swamy, A. S., Sridhara, S. Dinesh Kumar, M. vageesh, T. S and Nataraju, S. P. (2011). Heat use efficiency and Helio thermal units for maize genotypes as influenced by dates of sowing under southern transitional zone of Karnataka State. *Int. J. Sci. Nature,* 2 (3): 529-533.

Ketring, D. L. and Wheless, T. G. (1989). Thermal requirements for phonological development of Peanut. *Agron. J.,* 81 (6): 910 – 917.

Rajput, R. P. (1980). Response of soybean crop to climatic and soil environments. Ph.D thesis, IARI, New Delhi, India.

Sharma, K., Singh, G., Sharma, R., Sharma, H. L. and Singh. (1989). Biochemical changes in groundnut seed during germination under water stress conditions. *Ann. Biol.*, - (Ludhiana) 5(2) : 123-127.

Thavaprakash, N., Jagannathan, R., Velayudham and Guru sanny, L. (2007). Seasonal influence phonology and accumulated heat units in relation to yield of baby corn. *Int. J. Agric. Res.*, 2(9):826-831.

White, J. W., Reynolds, M. P. (2003) A physiological perspective on modeling temperature response in wheat and maize crops. In: White J. W. (ed) modeling temperature response in wheat and maize proceedings of a workshop CIMMYT, EL Batan, Mexico, 23-25 April 2001 CIMMYT, Mexico city, P 8 -17.