Open access Journal International Journal of Emerging Trends in Science and Technology
IC Value: 76.89 (Index Copernicus) Impact Factor: 4.219 **DOI:** https://dx.doi.org/10.18535/ijetst/v4i3.07

Phenology of Fingermillet (*Eleusine coracana* L.) in Relation to Agro-Climatic Indices under Different Sowing Dates

Authors
***T. Revathi, M Sree Rekha.**
Department of Agronomy, Agricultural College, Bapatla
**tompala.ravathi@gmail.com*

ABSTRACT
A field experiment was conducted during kharif 2015 at Agricultural College Farm, Bapatla on sandy loam soil to study the phenology, accumulated growing degree days, photo thermal unit, helio-thermal unit, heat use efficiency and performance of fingermillet varieties grown under different sowing dates. The crop was sown on 2nd fortnight of July took maximum calendar days, growing degree days, photo thermal unit, helio-thermal unit to attend different phonological stages till maturity. The genotype sown on 2nd fortnight of July (D_2) growth and yielded higher. The highest drymatter (3665kg ha^{-1}) at harvest and grain yield (2305 kg ha^{-1}) was recorded with (D_2) 2nd fortnight of July sowing. Among the varieties Chaitanya took highest calendar days growing degree days, photo thermal unit, helio-thermal unit to reach the maturity. The variety Chaitanya recorded the highest grain yield at 2nd fortnight of July sowing as compared to all other sowing dates.
Key words: *Finger millet, Grain yield, growing degree day, photo-thermal units,helio-thermal units.*

Introduction

Finger millet (*Eleusine coracana* L.) is an important food crop next to rice, wheat and maize, valued as a staple food. In India it has the pride place of having highest productivity among millets. India produced 1.44 Mt of finger millet from 1.19 M ha with an average productivity of 1210 kg ha^{-1} (Ministry of Agriculture, Government of India, 2014-15).The optimum sowing time and selection of improved cultivars play a remarkable role in exploiting the yield potential of the crop under particular agro climatic condition. It governs the crop phonological development and the efficient conversion of biomass into economic yield. Delay in sowing caused early maturity resulting drastic reduction in yield as compare to normal sowing which has a longer growth duration which consequently provides an opportunity to accumulate more biomass. Growing of suitable varieties at an appropriate time is an essential for ensuring optimum crop productivity. Temperature is an important environmental factor influencing the growth and development of crop plants. It influences the crop phenology and yield of crop (Bishnoi et al., 1995). Plants have a definite temperature requirement to attain phenological stages. Hence, it becomes imperative to have knowledge of the exact duration of phonological stages in a particular crop-growing environment and their impact on yield of crop. Therefore, an experiment was conducted to determine the phenology and heat unit requirement of promising fingermillet varieties under differentcrop growing environment.

Material and Methods

The experimental soil was sandy loam having pH 6.86 and organic carbon 0.10 per cent. The available nitrogen, phosphorus and potassium contents were 56.4, 25.6, and 250.0 kg ha^{-1}, respectively. The experiment was laid out in Randomized Block Design with factorial concept in three replications and consisted of nine

treatments, viz., three varieties (Chaitanya, Bharathi and Hima) and three dates of sowings (1st fortnight of July, 2nd fortnight of July and 1st fortnight of August). A uniform dose of 60:30:30 kg NPK per hectare was applied to the experimental plots. Entire quantity of phosphorus and potash and 1/3 of nitrogen was applied as basal. The remaining nitrogen was applied in two equal splits at 30 DAS and 60 DAS. Biometric observation on growth, yield attributes and grain yield were recorded. All the data recorded in the study were subjected to statistical analysis using Fisher's method of analysis of variance suggested by Panse and Sukhatme (1978) as outlined for the design adopted in this study. The growth phases (phenophases) of finger millet viz., maximum tillering, anthesis and maturity were identified from treatment whose 50% of the population exhibited the condition physiologically for better understanding of the influence of Agro-climatic parameters on fingermillet.

Phase 1: Sowing to maximum tillering
: Maximum tillering phase
Phase 2: Maximum tillering to flowering
: Anthesis phase
Phase 3: Sowing to Physiological maturity
: Maturity phase

Results and Discussion

Fingermillet *phenology and thermal indices*

The number of days taken to different phenophases from maximum tillering stage to maturity ranged from 19 to 115 days for different dates of sowing and varieties. Among dates of sowing, 2nd fortnight of July (D_2) took the maximum days (115days) to maturity. Crop took 19-24 days for maximum tillering 52-62 days for anthesis and 94-115 days for maturity phase. Among the varieties, the mean maximum days to attain all three phases were recorded with varieties (V_1) Chaitanya, followed by (V_2) Bharathi and the least was with (V_3) Hima.

Growing Degree Days

For different dates of sowing and varieties, the accumulated GDD from sowing to maturity during different phenophases ranged from 362 to 2155. Crop took 2155 units accumulated GDD with total 115 days till physiological maturity. This explains the direct impact of temperature on crop growth every crop needs a certain amount of GDD to enter its next crop stage (Table 1). Heat unit concept was applied to correlate phonological development in crops to predict maturity dates (Rao *et al.*,1999). Late sowing decreased the duration of phenology as compared to early sowing due to fluctuated un-favourable high temperature during the growing period. Among the sowing dates, 2nd fortnight of July recorded the highest GDD might be due to longer crop duration and optimum temperature range (Murthy, 1999). Among the varieties, Chaitanya accumulated the highest GDD which might be due to its higher crop growth days (115 days) compared to Bharathi and Hima.

Heliothermal Thermal Unit (HTU)

The accumulated HTU at maximum tillering stage ranged from 1344 to 2243 and at anthesis and maturity it ranged from 2557 to 3280 and 8374 to 10189, respectively for different dates of sowing. HTU is the product of GDD and actual bright sun shine hours, higher BSS results in more units of HTU. Several studies in India have shown that a delay of 20 days in sowing could cause a delay in flowering by 8 days or upto 13 days. (Brar *et al*., 2011). Among the sowing dates, the highest 10189 HTU was recorded with 2nd fortnight of July (D_2) followed by 1st fortnight of August (D_3) with 9834. The accumulated HTU were higher with 2nd fortnight of July (D_2) which might be due to higher bright sunshine hours during its crop duration (Rajput *et al.*1987). Similar results were also reported by Padma (2008), Girijesh *et al.* (2011) Patidar (2013) and Pal *et al.* (2013).

Photo Thermal Unit (PTU)

The accumulated PTU from maximum tillering to maturity ranged from 4529 to 25652 PTU for different dates of sowing and varieties. Crop took 25652 accumulated PTU with total 115 days till physiological maturity Among the sowing dates, the highest (25652) PTU was recorded with 2nd fortnight of July sowing (D_2) with Chaitanya which might be highest heat units compared with late sowing.

Thermal use efficiencies of three fingermillet varieties

Chaitanya variety sown on 2nd fortnight of July recorded highest HUE, PtUE and HtUE of 1.07, 0.23 and 0.09 kg ha^{-1} $^0C^{-1}$ d^{-1}, with grain yield 2313 kg ha^{-1}. Among the varieties, Chaitanya performed better than Bharathi and Hima in terms of HUE for drymatter production and HUE for grain yield. The highest HUE for drymatter was recorded with 2nd fortnight of July sowing (D_2) for Chaitanya followed by Bharathi and Hima

Table 2.Thermal use efficiencies of finger millet varieties at different dates of sowing

Dates of Sowing	Grain yield	HUE	HtUE	PtUE
Chaitanya (V1)				
(D1) 1 st Fortnight of July	2064	1.02	0.22	0.08
(D2) 2 nd Fortnight of July	2313	1.07	0.23	0.09
(D3) 1 st Fortnight of August	2141	1.04	0.22	0.09
Bharathi (V2)				
(D1) 1 st Fortnight of July	1672	0.85	0.18	0.07
(D2) 2 nd Fortnight of July	2378	1.16	0.25	0.10
(D3) 1 st Fortnight of August	1934	0.97	0.20	0.08
Hima (V3)				
(D1) 1 st Fortnight of July	1684	0.90	0.20	0.07
(D2) 2 nd Fortnight of July	2367	1.18	0.25	0.10
(D3) 1 st Fortnight of August	1819	0.97	0.19	0.08

Table 4.8. Accumulated units required for attainment of phenophases and indices for fingermillet varieties at different dates of sowing

Growth stages	Dates of sowing											
	1 st Fortnight of July				2 nd Fortnight of July				1 st Fortnight of August			
	Days to attain phenophases	GDD	HTU	PTU	Days to attain phenophases	GDD	HTU	PTU	Days to attain phenophases	GDD	HTU	PTU
Chaitanya (V_1)												
Maximum Tillering	20	423	2243	5291	24	478	1921	5928	22	436	2125	5367
Anthesis	52	654	2742	8079	62	763	3231	9285	60	753	2964	9008
Maturity	102	2016	9584	24459	115	2155	10189	25652	112	2060	9834	24211
Bharathi (V_2)												
Maximum Tillering	19	402	2171	5035	22	441	1811	5476	20	394	2070	4849
Anthesis	52	675	2877	8338	57	700	2842	8537	56	716	2640	8608
Maturity	99	1960	9132	23827	108	2056	9673	24542	105	1997	9606	23509
Hima (V_3)												
Maximum Tillering	21	362	1897	4529	19	382	1344	4748	19	372	1961	4583
Anthesis	54	675	3280	9360	56	738	3232	9020	54	695	2557	8384
Maturity	94	1867	8374	22757	105	2009	9427	24016	101	1884	9397	22247

References

1. Bishnoi, O. P., Singh, S. and Niwas, R., 1995, "Effect of temperature on phonological development of wheat (*Triticum aestivum* L.) crop in different row orientations", *Indian J. Agric. Sci.*, 65, 211-214.

2. Brar, S. K., Mahal, S. S., Brar, A. S., Vashist, K. K. and Buttar, G. S., 2011, "Phenology, heat unit accumulation and dry matter partitioning behaviour of two cultivars transplanted on different dates", *Journal of Agrometeorology*, 13 (2), 153-156.
3. Girijesh, G.K., Kumara Swami, A.S., Sridhar, 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. *International Journal of Science and Nature*. 2(3): 529-533.
4. Ministry of Agriculture, Government of India, 2014-15, *http://www.indiastat.com*
5. Murthy V R K 1999 Studies on the influence of macro and micro meteorological factors on growth and yield of Soyabean (Glycine max) *Ph.D Thesis* ANGRAU, Hyderabad, Rajendranagar.
6. Padma, S. 2008. Agroclimatic model for prediction of growth and yield of rice (*Oryza sativa* L.). *M.Sc. (Ag.) Thesis*. Acharya N.G. Ranga Agricultural University Rajendranagar, Hyderabad, India.
7. Pal, R.K. and Murty, N.S. 2013. Thermal requirements of wheat under different growing environments of tarai region (Uttarakhand). ISPRS archives XXXVIII-8/W3 *Workshop Proceeding: Impact of Climate Change on Agriculture*. pp.- 78-79.
8. Panse, V.G. and Sukhatme, P.V. 1978. Statistical methods for agricultural workers, ICAR, New Delhi, pp.- 145-150.
9. Patidar, N 2013.Agro climatic model for prediction of growth and yield of *rabi* maize(*Zea mays L.*).*M.Sc.(Ag)Thesis*. Acharaya N.G Ranga Agricultural University, Rajendranagar, Hyderbad, India.
10. Rajput, R.P. 1980. Response of soybean crop to climatic and soil environments. *Ph.D. Thesis*. Indian Agricultural Research Institute, New Delhi, India.
11. Rao, V.U M ., Diwan Singh and Singh, R. 1999. "Heat unit efficiency of winter wheat crops in Haryana". *Journal of Agrometeorology*. 1(2):143-148.