Madras Agric. J. 73 (2): 101-104 February, 1986

HEAT UNIT EFFICIENCY IN PIGEONPEA

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An experiment conducted in pigeonpea under three different date of sowing revealed that the heat unit efficiency was higher in the February 21 sowing than the June 21 and September 21 sowings. Seed yield had positive and significant association with heat unit efficiency on flowering and harvest stages. This study also suggests that heat unit efficiency can be used as a measure of crop efficiency for heat use under varying agroecological situations.

 Crop production is mainly depends upon the climatic requirement of the particular crop. Temperature had been know to affect the adaptability of a crop (Wallis, et al., 1980). Crop productivity was also inhibited at temperature higher than optimum (Gilmore and Rogers, 1958). The efficiency of temperature utilisation -or heat use is also varied depending upon the variety and also locations. Rajout (1980) calculated the heat unit efficiency for soybean and compared the performances of the varieties sown under different dates with respect to utilisation of heat in terms of degree days during the crop growth. So far, this kind of approach in pigeonpea is very limited. So, the present study was aimed at to find out the heat unit efficiency of pigeonpea cultivars sown under different seasons.

MATERIALS AND METHODS

The experiment was laid out under field conditions in Millet Breeding Station, Tamil Nadu Agrl, University, Coimbatore. Six pigeonpea cultivars comurised of three (150-180 days) long duration (COR G 11, PLS 361/1 and SA 1) and three (105-120 days) short duration (CO.5, CORG. 5 and UPAS 120) cultivars were selected for the study. The trial was conducted in three different sowing dates viz., 21-2-84, 21-6-84 and 21-9-84 in a Randomised Block Design with three replications. The total dry matter accumulation (DMA) was recorded at 30th day after sowing, flowering and harvest stages. Growing degree days (GDD) or effective heat unit was calculated as per the method suggested by Iwata (1984). This is an arithmatic accumulation of daily

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mean temperature above certain threshold temperature.

Degree days =
$$(Maximum + Minimum)$$

base temperature

The temperature 15° C was considered as base temperature (Johansen, 1984) for pigeonpea for calculating the degree days. The maximum and minimum daily temperatures were observed in the Meteorological observatory located in the Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore-3. The heat unit efficiency (HUE) was calculated as follows (Rajput, 1880).

Heat unit efficiency =
$$\frac{(DMA (g.m-2))}{GDD}$$

The recorded seed yield or harvest stage was subjected to simple correlation with heat unit efficiency.

RESULTS AND DISCUSSIONS

 Data on growing degree days dry matter accumulation (GDD), (DMA) and heat unit efficiency (HUE) were presented in Table 1. The GDD ncreased steadily from 30th day after sowing to harvest. The long duration cultivars exhibited higher GDD in flowering and harvest stages. Similar trend was also noticed in the case of DMA. The high amount of DMA in the long duration cultivars was due to its longer cropping period (150-210 days) in all the three sowings. Dry matter yield as high as 23 t ha-1 had also been reported from Australia for a long duration cultivars Cv. UQI - (Akinola and Whiteman, 1974); GDD and DMA were decreased progressively from 21-2-84 sowing to 21-9-84 in both type of cultivars except at 30th day where the highest GDD was observed 21-6-84 sown crops followed by 21-2-84 and 21-9-84. This might be due to the high mean temperature prevailed during that period.

With regard to HUE, it increased as the age of the crop advanced except in the 21-2-84 sown crops where the cultivars UPAS 120, CORG 11, PLS 361/1 and SA 1 recorded declining trend at harvest stage. The HUE as a measure of amount of GDD required to produce unit-amount of DMA, is mainly depended upon the daily mean temperatures during the cropping period (Uchijma, 1975). In the present study also, the high-DMA, GDD and HUE could be related to the comparatively higher mean temperature 27.65° C in 21-2-84 than the 21-6-84 (26.8° C) and 21-9-84 (24,43° C).

Correlation of HUE with seed yield revealed that the association was found to be positively significant in all the stages of corp growth except at 30th day (r=0.2661). The highest significant association (r=0.9882**) was noticed at harvest stage followed by flowering phase (r=0.0833). A Similar correlation in pigeonpea was also obtained earlier by chi-chu wang (1979).

Table 1. Heat Unit Efficioncy

Cultivar GDD DMA HUE GDD UMA HUE GDD DMA HUE GDD CORG 5 319.2 3.87 0.0129 855.6 486.09 0.5681 1685.7 1110.02 0.6585 UPA S 120 319.2 3.71 0.0129 855.6 486.09 0.5681 1685.7 1110.02 0.6585 UPA S 120 319.2 3.77 0.0118 768.4 334.93 0.4416 1518.1 665.04 0.4315 CORG 11 319.2 2.71 0.0085 1639.6 10497.54 6.4025 2569.9 11869.95 4.5155 PLS 361/1 319.2 3.74 0.0110 1735.0 11483.27 6.6036 2729.9 12918.59 4.7232 CORG 11 319.2 3.74 0.0107 1773.0 11801.17 6.6560 2729.9 12918.59 4.7323 CORG 11 347.5 2.79 0.0080 768.9 187.47 0.2477 1375.0 686.52 0.46229 UPA S 120 0.0085 1375.0 967.25 0.7081 1902.5 1402.96 0.8734 PLS 361/1 347.5 2.97 0.0086 1375.0 967.25 0.7081 1902.5 1679.60 0.8734 PLS 361/1 347.5 2.97 0.0086 1375.0 967.25 0.7081 1902.2 1679.60 0.8738 UPA S 120 0.0076 590.8 349.7 0.0084 1947.3 1680.59 0.8630 CORG 11 307.6 2.58 0.0084 636.3 497.2 0.0781 1097.8 376.43 0.3429 UPA S 120 0.0084 636.3 349.8 0.0084 636.3 349.8 0.0084 885.9 283.06 0.3376 1374.6 704.49 0.5129 PLS 361/1 307.6 2.28 0.0008 888.4 0.3376 1374.6 704.49 0.5129 PLS 361/1 307.6 2.28 0.0008 888.9 2.3339 1604.3 825.47 0.5487 0.5487 SE CDB	Date of	-	4	30th day		- ⁻ :	Flowaring	. Ç		Harvest	•	Seed
CO 5 319.2 3.87 0.0121 811.6 472.49 0.5834 1562.5 982.87 0.5329 UPAS 120 319.2 4.13 0.0129 855.5 486.09 0.6881 1686.7 110.02 0.6885 COR G 11 319.2 2.71 0.0035 1632.6 10497.54 6.4025 2569.9 11869.95 4.5155 1180.32 0.4416 1518.1 665.04 0.4315 COR G 11 319.2 2.71 0.0035 1632.6 10497.54 6.4025 2569.9 11869.95 4.5155 1180.3 17.5 31.3 0.0090 766.9 187.47 0.2191 1343 0 543.7 0.4049 COR G 5 347.5 2.79 0.0030 766.9 187.47 0.2477 1375.0 636.52 0.4629 0.008 1347.5 0.0030 766.9 187.47 0.2477 1375.0 636.52 0.4629 0.008 1343.0 1018.13 0.7881 1902.5 1402.96 0.7374 0.4049 0.7381 1347.5 2.79 0.0086 1343.0 1018.13 0.7881 1902.5 1402.96 0.7374 0.4049 0.7381 1347.5 2.97 0.0086 1343.0 1018.13 0.7881 1902.5 1402.96 0.7374 0.403 0.7381 1347.5 2.59 0.0097 6.46.4 57.13 0.0984 1947.3 1680.59 0.8738 0.8738 0.7881 1375.0 0.0084 636.3 0.7881 1902.5 1679.60 0.2779 0.788 130.7 0.0084 636.3 0.00	guiwos	Cultivar	GDD [days]	DMA [g:m-e]		GDD [days]	OMA [g.m-*]	HUE	GDD [days]	· DMA [g m-³]	HUE	yield [g.plant-
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CORG 11 319.2 2.71 0.0085 1639.6 10497.54 6.4025 2569.9 11869.95 4.5155 PLS 361/1 319.2 3.54 0.0110 1735.0 11463.27 6.6036 2665.7 12590.58 4.7232 SA 1 319.2 3.40 0.0107 1773.0 11801.17 6.6560 2729.9 12918.59 4.7323 CORG 5 347.5 2.79 0.0080 766.9 187.47 0.2477 1375.0 636.52 0.4629 UPAS 120 347.5 2.79 0.0080 766.9 187.47 0.2477 1375.0 636.52 0.4629 UPAS 120 347.5 2.97 0.0086 1343.0 1018.13 0.7581 1902.5 1402.96 0.7374 PLS 361/1 347.5 2.97 0.0086 1343.0 1018.13 0.7581 1902.5 1402.96 0.7374 PLS 361/1 347.5 2.68 0.0087 646.4 57.13 0.0886 1947.3 1680.59 0.8630 CORG 5 307.6 2.58 0.0076 590.8 34.53 0.0584 1046.6 340.86 0.3257 CORG 11 307.6 2.58 0.0076 590.8 34.53 0.0584 952.4 267.60 0.2779 CORG 11 307.6 2.28 0.0074 857.9 283.06 0.3376 1374.6 704.49 0.5129 PLS 361/1 307.6 2.28 0.0078 838.4 2283.06 0.3376 1374.6 704.49 0.5129 PLS 361/1 307.6 2.28 0.0078 888.9 249.72 0.3319 1504.3 825.47 0.5487 SE		UPA S 120	319.2	3.77	0.0118	758,4	334,93	0,4416	1518.1	655,04	0,4315	33.58
PLS 361/1 319.2 3.54 0.0110 1735.0 11463.27 6.6036 2665.7 12690.58 4.7232. SA 1 319.2 3.40 0.0107 1773.0 11801.17 6.6660 2729.9 12918.59 4.7323. CO 5 347.5 3.13 0.0090 768.9 161.54 0.2101 1343.0 543.74 0.4049 COR G 13 347.5 2.79 0.0080 756.9 187.47 0.2477 1375.0 636.52 0.4629 UPAS 120 347.5 2.79 0.0080 756.9 187.47 0.2477 1375.0 636.52 0.4629 PLS 361/1 347.5 2.97 0.0088 1343.0 1018.13 0.7581 1902.5 1402.96 0.7374 PLS 361/1 347.5 2.97 0.0085 1375.0 967.25 0.7081 1902.5 1679.60 0.8738 SA 1 347.5 2.09 0.0088 636.3 698.73 0.6886 1947.3 1680.59 0.8630 COR G 11 307.6 2.53 0.0076 590.8 34.53 0.0584 962.4 267.50 0.2779 PLS 361/1 307.6 2.28 0.0078 857.9 283.06 0.3299 1456.5 573.73 0.3939 SA 1 307.6 2.28 0.0081 886.9 249.42 0.3319 1504.3 825.47 0.5487	11.2.84	COR G 11	319.2	2.71	0.0085	1639,6	10497,54	6,4025	2569.9	11859,95	4,61,55	160,60
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347.5 3.65 0.0105 1406.8 968.73 0.6886 1947.3 1680.59 0.8630 307.6 2.68 0.0087 646.4 57.13 0.0884 1046.6 340.86 0.3257 120 307.6 2.57 0.0084 636.3 49.72 0.0781 1097.8 376.43 0.3429 11 307.6 2.33 0.0076 590.8 34.53 0.0584 962.4 267.50 0.2779 11 307.6 2.28 0.0074 857.9 283.06 0.3299 1456.5 573.73 0.3939 1307.6 2.50 0.0081 886.9 249.42 0.3319 1504.3 825.47 0.5487		PLS 361/1	347.5	2.97	0.0085	1375.0	967,25	0.7038	1922,2	1679.60	0,8733	50.40
507,6 2,68 0,0087 646,4 57,13 0,0884 1046.6 340,86 0,3257 120 307,6 2,57 0,0084 636,3 49,72 0,0781 1097.8 376,43 0.3429 120 307,6 2,33 0,0076 590.8 34,53 0,0584 962.4 267,50 0,2779 11 307,6 2,09 0,0068 838.4 283.06 0,3376 1374.6 704.49 0,5129 31/1 307,6 2,28 0,0074 857,9 283.06 0,3299 1456.5 573.73 0,3939 307,6 2,50 0,0081 886,9 249,42 0,3319 1504.3 825.47 0,5487		SA 1	347.5	3,65	0.0105	1406.8	968,73	0,6886	1947.3	1680,59	0.8630	59.10
5 307.6 2.57 0.0084 636.3 49.72 0.0781 1097.8 376.43 0.3429 120 307.6 2.33 0.0076 590.8 34.53 0.0584 962.4 267.60 0.2779 11 307.6 2.09 0.0068 838.4 283.06 0.3376 1374.6 704.49 0.5129 31/1 307.6 2.28 0.0074 857.9 283.06 0.3299 1456.5 573.73 0.3939 307.6 2.50 0.0081 886.9 249.42 0.3319 1504.3 825.47 0.5487	*	200	307.6	2,68	0.0087	646,4	57,13	0.0884	1046.6	340,86	0,3257	13,40
120 307.6 2.33 0.0076 590.8 34.53 0.0584 962.4 267.50 0.2779 11 307.6 2.09 0.0068 838.4 283.06 0.3376 1374.6 704.49 0.5129 31/1 307.6 2.28 0.0074 857.9 283.06 0.3299 1456.5 573.73 0.3939 307.6 2.50 0.0081 886.9 249.42 0.3319 1504.3 825:47 0.5487		COR G 5	307.6	2.57	0,0084	636,3	49.72	0.0781	1097.8	376.43	0.3429	16.74
11 307.6 2.09 0.0068 838.4 283.06 0.3376 1374.6 704.49 0.5129 31/1 307.6 2.28 0.0074 857.9 283.06 0.3299 1456.5 573.73 0.3939 307.6 2.50 0.0081 886.9 249.42 0.3319 1504.3 825:47 0.5487			307.6	2.33	0.0076	590.8	34.53	0.0584	962.4	267.50	0.2779	10.07
361/1 307.6 2.28 0.0074 857.9 283.06 0.3299 1456.5 573.73 0.3939 1 307.6 2.50 0.0081 886.9 249.42 0.3319 1504.3 825.47 0.5487		COR G 11	307.6	2.09	0,0068	838.4	283.06	0.3376	1374.6	704.49	0.5129	35.87
1 307.6 2,50 0.0081 886,9 249,42 0.3319 1504.3 825:47 0.5487		PLS 361/1	307.6	2.28	0.0074	857.9	283.06	0.3299	1456.5	573.73	0.3939	25.67
		SA 1	307.6	2,50	0.0081	886,9	249,42	0,3319	1504.3	825.47	0,5487	37.16
		SE	ı	1	1	Ť	1	i	1	ă	-1:	1,651
		S	1	ĵ	ĺ	ĩ	1	1	į	1	1	4.976

The present study pointed out that the crop growth is mainly depended upon the effective utilization of heat or temperature prevailed during the cropping period. The HUE clearly differentiated the efficiency of the cultivars under different sowing dates. The seed yield was also found to have significant association with HUE. So, this HUE can be used as a measure of crop efficiency under varying agroecological niche.

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