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Determination of sowing time for chickpea varieties in south Saurashtra, India

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ABSTRACT

A field experiment, involving four dates of sowing and four varieties of chickpea was undertaken to find out suitable sowing date. The yield attributes were significantly influenced by different dates of sowing. Statistically significant yield was obtained from both first and the second date of sowing i e 15th and 25th Oct. respectively. The optimum thermal unit requirements are GDD 1884, HTU 1535 and PTU 20944. The heat use efficiency was the highest in the second date of sowing and the lowest in the last date of sowing. The identified time of sowing for chickpea was from 15th to 25th Oct. for optimal thermal regime under south Saurashtra agroclimatic zone.

Key words : Chickpea, Thermal unit, HUE, Thermal use efficiencies.

Sowing during appropriate time enables the crop to take full advantage of favorable weather conditions. Sowing time for rainy season crops can be determined through information on onset and withdrawal of monsoon, probability of rainfall and rainfall distribution. However, determination of sowing time for winter crops depends upon heat unit requirement and thermal use efficiency of crops.. Chickpea is a thermo sensitive winter season pulse crop. Several workers (Srivastava *et al*, 1990, Patel *et al*, 1999 and Sharma *et al*, 1999) studied the response of chickpea cultivars under different dates of sowing in different regions of Madhya Pradesh, Gujarat and Hill zone of Assam respectively.

The heat use efficiency of chickpea in Haryana (Rao *et al*, 1999), in peninsular India (Sengupta *et al*, 2003) and assessment of phenology was studied by Agarawal *et al* (2002). Meena and Dahama (2004) used this concept for deciding sowing time of groundnut in western Rajasthan. Here, an attempt has been made to determine appropriate sowing time for chickpea in South Saurashtra agroclimatic zone through heat unit systems and thermal use efficiency ratings.

MATERIALS AND METHODS

Four varieties of chickpea viz. Gujarat Gram-1 (V1), Dahod Yellow (V2), KAK-2 (V3) and PG-5(V4) were sown on four

different dates viz 15th Oct, 25th Oct, 4th Nov and 15th Nov at an interval of 10 days during winter season of 2002-03 on the research farm of Junagadh Agricultural University, Junagadh, in a split plot design with dates of sowing as main plot and varieties as sub-plot treatment. The crop was raised using recommended agronomic practices for the region on medium black calcareous soil.

Periodical observations on phenological development yield and yield attributing characters (Table 1) were recorded. Growing degree days (GDD) were calculated using base temperature of 5°C from daily mean temperature. The photothermal unit (PTU) and heliothermal unit (HTU) were calculated as the products of maximum possible bright sunshine hours (N) and actually measured bright sunshine hours (n) with GDD respectively.

The thermal use efficiency (TUE) for seed yield was computed as

1. Heat Use Efficiency (HUE) = Seed yield (kg ha^{-1}) / GDD °C day.
2. Heliothermal use Efficiency (HTUE) = Seed yield (kg ha^{-1}) / HTU °C hr.
3. Photothermal use Efficiency (PTUE) = Seed yield (kg ha^{-1}) / PTU °C hr.

RESULTS AND DISCUSSION

Yield and yield attributes

Significantly higher yield (1191 kg ha^{-1}) was recorded under second date of sowing(D_2) followed by first date of sowing (1135 kg ha^{-1}) (Table 1), and significantly lower yield under third date (893 kg ha^{-1}), and fourth dates (582 kg ha^{-1}). Among the varieties, significantly higher yield was recorded by GG-1, (1120 kg ha^{-1}), followed by Dahod Yellow (1050 kg ha^{-1})

The yield attributing characters were also significantly influenced by the date of sowing (Table-1). The first date of sowing recorded significantly higher no. of branches/ pods per plant, and higher test weight whereas second date of sowing recorded higher no of effective branches and pods per plant. The plant height was not significantly affected by the sowing date.

Among varieties GG-1 recorded significantly higher no. of branches and effective branches per plant, no. of pods per plant and test weight.

Duration of phenophases

Date of sowing significantly influenced the duration of crop growing period. On the basis of date of sowing, variations in total maturity periods as well as the phenophasic periods of chickpea were noted (Table 2) indicating that successive delay in sowing reduced the duration to maturity. The duration of vegetative period (P_1) for all sowing dates was not influenced but subsequently the flowering, (P_2) podding (P_3) and maturity (P_4) periods were considerably influenced by the sowing date. The first date of sowing has the longest period of growth. Among the varieties the longest period of maturity was recorded in case of GG-1 (99 days) and the shortest in case of KAK-2 (85 days).

Table 1 : Effect of sowing dates on yield and yield attributes of chickpea cultivars.

Treatments	Plant height(cm) at maturity	No of branches plant^{-1}	No of effective branches plant^{-1}	No of pods plant^{-1}	Test weight (g) (100 seeds)	Seed yield (kg ha^{-1})
Date of sowing						
D1	30.0	8.0	5.6	28.0	27.0	1135.0
D2	30.0	7.5	5.7	27.0	26.0	1191.0
D3	29.0	6.9	4.2	23.0	24.0	893.0
D4	30.0	3.8	2.5	14.0	22.0	582.0
S Em	0.67	0.13	0.16	1.0	0.03	-
CD at 5%	NS	0.52*	0.53*	3.0*	0.08*	142.4*
Varieties						
V1	26.7	7.0	5.0	33.0	20.0	1120.0
V2	30.9	6.0	4.6	29.0	17.0	1050.0
V3	32.6	7.0	4.6	15.0	35.0	948.0
V4	29.3	6.0	3.7	15.5	27.0	773.0
S Em	0.53	0.17	0.15	0.79	0.04	-
CD at 5%	1.52*	0.48*	0.44*	2.27*	0.11*	266.7*
Interaction						
S Em	1.06	0.33	0.31	1.58	0.08	0.217
CD at 5%	3.00*	0.95*	0.88*	4.55*	0.23*	NS
CV %	7.00	10.0	14.00	14.00	0.04	31.0

Sowing time and accumulated thermal units

The first date of sowing (D_1) accumulated the highest thermal units as compared to subsequent sowing periods, followed by second date of sowing ie on 25th October. Hence the optimum thermal unit requirement might be 1884 GDD, 15354 HTU and 20944 PTU for obtaining higher yield of chickpea at Junagadh (Table-2).

Among the varieties the thermal units for maturity ranged from 1659 to 1902, HTU from 15093 to 17503 and PTU from 18459 to 21161 from sowing to maturity. The variety GG-1 accumulated highest thermal units. Among sowing dates D1 recorded highest thermal unit accumulation , but the highest yield was obtained from second date of sowing (D_2).

Relationship of thermal indices and weather parameters with yield

Strong and positive correlation at 5% significance level was observed between thermal time indices ,accumulated maximum, minimum, mean and range of temperature, actual sunshine hours and day length with yield of chickpea under different sowings.(Table -3)

Table 2 : Duration and accumulated heat units for different phenophases of chickpea.

Treatments	P1	P2	P3	P4	Total
Date of sowing	Duration (days)				
D1 (15th Oct.)	19	24	29	31	103
D2 (25th Oct.)	18	22	25	30	95
D3 (4th Nov.)	17	19	23	29	88
D4 (15th Nov.)	16	17	21	27	81
Varieties					
V1 (GG1)	19	21	28	31	99
V2 (Dahod Yellow)	18	20	23	28	89
V3 (KAK 2)	16	19	21	29	85
V4 (PG 5)	19	21	26	29	95
Growing Degree Days					
D1 (15th Oct.)	470	528	562	540	2099
D2 (25th Oct.)	427	446	484	526	1884
D3 (4th Nov.)	378	371	433	522	1704
D4 (15th Nov.)	327	329	374	495	1524
V1 (GG1)	440	407	487	567	1902
V2 (Dahod Yellow)	425	386	436	492	1741
V3 (KAK 2)	372	386	395	507	1659
V4 (PG 5)	446	411	452	540	1855
Heliothermal units					
D1 (15th Oct.)	4163	4549	5193	3229	17134
D2 (25th Oct.)	3763	3896	4592	3103	15354
D3 (4th Nov.)	3345	3194	3965	3215	13719
D4 (15th Nov.)	2804	3106	3016	3214	12139
V1 (GG1)	3770	3710	4540	5484	17503
V2 (Dahod Yellow)	3639	3485	4105	4653	15884
V3 (KAK 2)	3169	3464	3744	4716	15093
V4 (PG 5)	3833	3754	4214	5132	16934
Photothermal units					
D1 (15th Oct.)	5434	5935	6154	5945	23468
D2 (25th Oct.)	4878	4968	5293	5805	20944
D3 (4th Nov.)	4271	4099	4720	5776	18866
D4 (15th Nov.)	3639	3602	4089	5504	16834
V1 (GG1)	4856	4702	5338	6265	21161
V2 (Dahod Yellow)	4692	4422	4794	5437	19346
V3 (KAK 2)	4103	4427	4379	5550	18459
V4 (PG 5)	4933	4712	5240	4746	19631

P1 = Vegetative, P2 = Flowering, P3 = Podding, P4 = Maturity.

Table 3 : Correlation coefficients of heat indices and weather parameters with yield of chickpea.

Heat Indices / weather Parameters	Correlation Coefficients
GDD	0.891
HTU	0.899
PTU	0.887
Accu-Max-T	0.894
Accu-Min-T	0.887
Accu-Mean-T	0.902
Accu-Temp range	0.891
Max Temp	0.895
Min Temp	0.904
Mean Temp	0.896
Actual SS	0.906
Max SS	0.892

Thermal use efficiency

The efficiency of thermal energy and photothermal energy conversion for yield and dry matter production depend upon genetic factors of crop and sowing time. Three thermal use efficiencies such as HUE, HTUE and PTUE were calculated and presented in Table 4. Very interestingly it could be observed that the thermal use efficiencies were the highest for second sowing (25th October) followed by first and third sowings. Poorest efficiency was observed under the fourth sowing. Similar results were obtained by Rao *et al* (1999) at Hisar. Similarly amongst varieties, Dahod yellow showed better efficiency than GG-1 and KAK-2.

In south Saurashtra agro climatic zone, on the basis of the thermal efficiencies it can be concluded that chickpea varieties viz Dahod yellow, GG-1 and KAK-2 could be sown from 15th to 25th October for higher yield due to higher efficiencies of utilizing available heat and sun light during the growth period.

Table 4 : Thermal use efficiencies for different sowing dates and varieties of chickpea.

Treatments	Thermal use efficiencies		
	HUE	HTUE	PTUE
Date of sowing			
D1	0.54	0.066	0.048
D2	0.63	0.078	0.057
D3	0.52	0.065	0.047
D4	0.38	0.048	0.035
Varieties			
V1	0.59	0.064	0.053
V2	0.60	0.066	0.054
V3	0.57	0.063	0.051
V4	0.42	0.046	0.039

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