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Thermal regime requirement and plant responses of chickpea cultivars under variable weather conditions

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ABSTRACT

A field experiment was conducted during rabi season of 2006-07 and 2007-08 at Agromet Research Farm of N.D. University of Agriculture and Technology, Kumarganj, Faizabad with three chickpea cultivars viz. Awarodhi, Radhey and Uday grown under three dates of sowing. Results revealed that phasic duration and thermal unit from sowing to maturity decreased with successive delay in sowing. The accumulated thermal unit during the entire growth period of the crop decreased from 21370days under October 31 sowing to 17850 days under late sowing (sowing delayed by 20 days). Number of pods and number of seeds per pod increased with increasing temperature from 9.1-23.50C. Maximum temperature during reproductive stage had negative correlation on the yield. Yield decreased with successive increase of maximum temperature from 27.2-32.9^{0}C.

Key words: Thermal, plant responses, cultivars, weather, yield attributes

Chickpea which is commonly known as gram, and Bengal gram is grown in India during rabi season and it requires cool and dry weather for optimum growth. The crop is predominantly grown under rain fed condition and is raised mainly on conserved soil moisture. Optimum sowing temperature and selection of improved cultivars play a remarkable role in exploiting the yield potential of the crop under particular agro climatic conditions. Sowing dates has been proved to be one of the most non-monetary inputs affecting the yield of chickpea. Sub optimal thermal requirement during crop growing season are known to have profound effect on productivity. The optimum sowing time is important to exploit the environmental conditions during the growth of chickpea for maximum production. Delay in sowing causes early maturity resulting drastic reduction in yield. The productivity of chickpea in eastern U.P. is quite below than the national average which needs to improve by resource management (Shendge *et.al.*, 2002). The yield of chickpea fluctuates as it responds differently due to the variation in the thermal requirements of a given cultivars in a particular agro-climatic conditions. Keeping above facts in view, the present investigation was under taken.

MATERIALS AND METHODS

A field experiment was conducted during rabi season 2006-07 and 2007-08 at Agromet Research Farm of N.D. University of Agriculture & Techonology, Kumarganj, Faizabad, (U.P.) to study the thermal regime requirement and plant response of Chickpea cultivars under variable weather conditions. Geographically the experimental site was located at 26^{0}47'N latitude, 82^{0}12'E longitude and at an altitude of 113 meters above mean sea level in the north indogangetic plain. The experiment was conducted in split plot design comprised of three sowing dates (sowing on October 31 with temperature 24.7^{0}C; November 10 with temperature 21.1^{0}C and November 20 with temperature 20.7^{0}C) and three cultivars of chickpea (Awarodhi, Radhy and Uday). The experiment was replicated four times. The soil of the site was sandy loam and saline in reaction having pH 8.0, EC- 0.50, organic carbon 0.25% with available N 132.5 kg ha^{-1}, available P_2O_5 16.4 kg ha^{-1}and available K_2O 340. kg ha^{-1}. Sowing of seeds was done in rows 30 cm apart. An amount of 20 kg N+ 40 kg P_2O_5 were applied through urea and SSP and were given as basal just below the seed. Thermal unit at different phenological stages were calculated using base temperature of 5^{0}C (Nuttonson, 1955).

RESULT AND DISCUSSION

Growth attributes

Phasic duration and thermal unit requirements at different phenophases of chickpea decreased with delay in sowing from October 31 to November 20. The October 31 sown crop took longer duration for maturity (153 days) than the later sown crop in all the cultivars due to fulfillment of thermal unit requirements in more days and also due to

Table 1: Phase duration (days) at various phenological stages of chickpea (Pooled data over two years).

Treatment	Phenophases				
	Emergence	Vegetative	50% flowering	Pod formation	Pod Maturity
Sowing dates					
Oct. 31	6(105)	107(1350)	119(1613)	137(1916)	153(2137)
Nov. 10	7(117)	98(1215)	116(1367)	138(1533)	147(1947)
Nov. 20	7(117)	90(1110)	114(1203)	125(1394)	135(1785)
Cultivars					
Awarodhi	6(113)	100(1215)	115(1335)	134(1697)	145(2121)
Radhey	6(113)	105(1235)	118(1364)	137(1700)	150(2175)
Uday	6(113)	100(1226)	117(1360)	135(1618)	147(1946)

Figure in parenthesis indicates accumulated thermal units in ^0C

Table 2 : Dry matter accumulation (gm^{-2}) of chickpea as affected by various treatments (Pooled data over two years).

Treatment	Days after sowing									
	15	30	45	60	75	90	105	120	135	AH
Sowing dates										
Oct. 31	37.2	133.1	246.3	320.0	397.2	527.5	609.4	674.0	734.1	778.8
Nov.10	35.1	124.0	232.7	301.4	373.9	491.9	574.6	633.4	689.5	751.3
Nov. 20	30.3	106.0	203.9	266.9	329.1	437.8	481.4	546.8	623.2	664.8
SEm+	1.47	2.95	5.55	7.18	8.85	12.35	13.40	14.45	16.04	18.30
CD 5%	4.46	10.87	16.28	21.07	25.95	37.29	39.31	42.52	47.05	63.69
Cultivars										
Awarodhi	32.4	116.7	220.2	286.1	360.5	470.2	531.1	574.6	651.7	702.2
Radhey	35.4	124.0	233.7	302.9	382.7	498.8	571.1	633.6	703.2	752.5
Uday	33.1	118.1	221.6	289.6	363.5	472.7	539.1	602.5	661.4	710.6
SEm+	1.34	2.41	4.53	5.86	7.22	9.26	10.94	11.83	16.04	14.94
CD 5%	NS	7.08	13.29	17.20	21.19	27.18	32.10	34.72	47.05	43.84

Table 3 : Yield attributes and yield of chickpea as affected by treatments

Trs.	No. of pods per plant	No. of seeds per pod	100 seed weight (g)	Seed yield (q ha^{-1})	Biological yield (q ha^{-1})
Sowing dates					
Oct. 31	69.6	1.9	28.8	22.1	55.3
Nov.10	63.5	1.7	28.4	21.3	53.7
Nov. 20	57.6	1.5	27.8	20.2	52.4
SEm+	2.40	0.06	0.24	0.52	0.25
CD 5%	7.04	0.18	NS	1.53	0.74
Cultivars					
Awarodhi	60.2	1.6	26.9	19.2	50.3
Radhey	65.3	1.7	27.4	22.7	54.0
Uday	61.8	1.6	27.3	21.6	52.6
SEm+	1.90	0.05	0.15	0.42	0.20
CD 5%	5.52	0.15	NS	1.25	0.60

increase in vegetative growth duration (Table 1). The total thermal unit during the entire growth period of crop decreased from 21370 days under October 31 sowing to 17850 days under late sowing (sowing delayed by 20 days). Oct. 31 sown crop accumulated higher thermal units for all the growth stages followed by Nov.10th sowing (Singh, *et.al.* 2008) Nov.20th sowing reduced the crop duration by 18 days over Oct. 31st sowing and 12 days over Nov.10th sowing. Among the cultivars, Radhey had higher thermal unit requriement due to comparatively longer duration of maturity.

Dry matter accumulation varied significantly due to different crop growing environment at all the phenophases (Table 2). Significantly higher dry matter accumulation were recorded when crop was sown on Oct. 31 which was at par with crop sown on Nov.10th while significant over sowing on Nov. 20th late sown crop. Different varieties had significant effect on dry matter accumulation of chickpea at all the stages of chickpea. Radhey variety brought higher dry matter accumulation at all the stages.

Yield attributes and yields

Different yield attributes like number of pods per plant, number of seeds per pod, test weight and yield were significantly influenced due to crop growing environments (Table 3). Significantly higher yield attributes and yields were recorded in Oct. 31st sowing as compared to Nov. 10th and Nov. 20th sowing, the later two differed significantly with respect to them. Higher yields were recorded in Radhey cultivar as compared to Awarodhi. The number of pods-plant and number of seeds, plant of chickpea increased with increasing the average temperature from 9.1 to 23.50C while effect of maximum temperature during the reproductive stage had negative correlation on the yield. Yield decreased with successive increase in maximum temperature from 27.2 to 32.9^{0}C.

CONCLUSION

Conclusively, sowing temperature 24.70C which occurred on Oct. 31st gave significantly higher growth and yields due to optimal thermal requirement for various plant processes. The thermal unit requirement of chick pea decreased with delay in sowing. Delayed crop lower thermal unit during vegetative phase and higher thermal unit during podding stage which adversely affected the yield.

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