International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 626-629

Received: 04-11-2018
Accepted: 08-12-2018

Yamlesh Nishad
Department of Agrometeorology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

ASRAS Sastri
Department of Agrometeorology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Vinamarta Jain
Pt. SKS College of Agriculture and Research Station, Rajnandgaon Chhattisgarh, India

Correspondence
Yamlesh Nishad
Department of Agrometeorology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Studies on the effect of weather and irrigation on growth, development and yields of chickpea: A review

Yamlesh Nishad, ASRAS Sastri and Vinamarta Jain

Abstract
The present investigation entitled "studies on the effect of weather and irrigation on growth, development and yield's of chickpea under Raipur condition." was conducted during *rabi* season 2013-14 at Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). Chickpea (*Cicer arietinum*) is a grain legume, crop. Grown primarily for its high protein content '" (up to 30 %) (Jambunathan and Singh, 1990). It is cultivated mainly in the Indian sub-continent, but is gaining popularity in other countries around the world. It is the third most important pulse crop after common beans (Phaseolus vulgaris) and peas (Pisum sativum) (FAO, 1995). Kabir *et al*. (2009) conducted a field experiment during November 2000 to April 2001 at Hazipur, Bangladesh to study the effect of sowing time and cultivars on the growth and yield performance of chickpea under rainfed condition with Three chickpea varieties The varieties showed significant difference in case of plant height, canopy coverage, 100-seed weight, yield and harvest index. Sowing time showed significant difference with respect to plant height, crop growth rate, canopy coverage, number of pods/plant, number of seeds/pod, yield and harvest index. Seed yield was reduced consequently as the date of sowing was delayed. The late November sowing produced the highest seed yield and harvest index. The study further revealed that sowing date could be delayed upto early December to get satisfactory yield. So, it was suggested that BARI Chola-4 could be sown upto early December under rainfed condition for better yield.

Keywords: weather, irrigation, development, chickpea

Introduction

Climate and weather conditions which influence human activities and environmental resources sustainability include; rainfall, temperature (minimum, average, maximum), pressure, humidity, solar radiation, visibility, evaporation, soil temperature at various depths, wind speed and direction among others. The climate is the least manageable part of environmental resources, yet a better understanding of the climatic resources and their interaction with crops can help to increase the crop productivity.

Plant development depends on temperature and requires a specific amount of heat to develop from one point in their lifecycle to another, such as from seeding to the harvest stage. Temperature is a key factor for the timing of biological processes and hence regulates the growth and development of plants. Crop heat unit (CHU) or thermal time or growing degree days is a temperature response of development that differs between day and night. Growing degree days is a way of assigning a heat value to each day. Heat units are involved in several physiological processes like specific amount of heat units required for the plant at each stage from its germination to harvest of the crop and they would vary. The important processes are growth and development, growth parameters, metabolism, biomass, physiological maturity and yield. Growing degree days are used to assess the suitability of a region for production of a particular crop, determine the growth stages of crops, assess the best timing of fertilizer, herbicide and plant growth regulators application, estimate heat stress accumulation on crops, predict physiological maturity and harvest dates and ideal weather unit in constructing crop weather models. (Parthasarathi *et al*., 2013) [17]

The chickpea grain yield is related to its phenology which is influenced by temperature. The timing and duration of flowering has an important role in determining crop duration and grain yield at high temperature. The crop is forced into maturity under hot and dry condition (>30 ºC) by reducing the crop duration (Summerfield *et al*. 1984) [28].

Review of Literature

Crop growth is the result of many physical and physiological processes, each of which is affected by environmental factors. The main factors which have strong influence on crop growth and yield are air temperature, duration and quantity of light, radiation from the sun, cloudiness and precipitation.

Effect of time of sowing

Sowing date is one of the most important agronomic factors affecting chickpea productivity. The environmental factors which determine optimum sowing date are the pattern of moisture availability during plant growth, temperature and photoperiod. Sharma *et al.* (1988) [23] indicated delay in sowing four chickpea cultivars from 20 October to 30 October, 9 or 19 November decreased average seed yield from 1.68 to 1.46, 1.04 and 0.85 t per ha, respectively and also decreased number of branches and pods per plant, 100-seed weight and seed protein content. Cv G-2 gave the highest yield of 1.48 t per ha compared with 1.12 to 1.26 t for other cultivars. Shrivastva *et al.* (1990) [25] observed in Chhattisgarh region that under late sown condition, JG-74 was found significantly superior (1.82 t/ha.) to the other two cultivars. Singh *et al.* (1991) reported significantly higher grain yield of chickpea under Hisar condition on 20th October sown crop and lowest in last sowing (20th November). Saini and Faroda (1997) [22] observed that delay in sowing time decrease the plant height, dry matter/plant and leaf area/plant, while pods per plant, grain/pod and 100 seed weight improved with November first week sowing and also found that paired row planting of 20:40 cm and 30 cm row spacing gave significantly higher yield compared to 20 cm row spacing.

An experiment conducted by Kumar *et al*. (2003) indicated that the chickpea yield was significantly reduced beyond 25th November sowing. Number of pods per plant was also reduced beyond 25th November sowing, whereas other yield attributes *viz.* number of seeds/pod and 100 seed weight were not affected by sowing dates. Nagarajaiah *et al*. (2005) [16] A seed rate of 87.5 kg ha-1 recorded significantly higher seed yield (1502 kg ha-1) compared to 75.0 kg ha-1 (1306 kg/ha) and 62.5 kg ha-1 (1222 kg/ha). Crop sown during November 1st week recorded significantly higher seed yield (1756 kg ha-1) compared to other dates of sowing (869 to 1603 kg/ha). The decreased levels of P positively affected biomass and HI. There was proportionally change in biomass and HI with changing T. It was found various considerable interactions between variables for biomass, HI and ET. For example, when T was cool, high values of S and P synergistically decreased biomass. Badani *et al.* (2010) [5]. The results indicated that some chickpea cultivars could be commercialized for production of the fresh-harvested crop in semi-arid climates. Kaya *et al.* (2010) [12] Carried studies in 2006 and 2007 crop seasons at Turkey. To investigate the effect of sowing time and different seed treatments. Significant differences were detected for cultivars, sowing dates and seed treatments. 100 seed weight, harvest index and seed yields were significantly affected from sowing dates and seed treatments. Agegnehu and Sinebo (2012) [1]. Improved varieties were significantly more yielding than the landrace variety under the improved drainage system but not under the flat bed system. Also, improved varieties yielded significantly more than the landrace variety in the first three sowing dates when water logging was a problem but not in the last sowing date after which drought stress normally sets in.

Yield and yield attributes

Thakur *et al.* (1998) [30] conducted a field trial during winter season of 1990-91 and 1991-92 at Ujjain (M.P.) with two chickpea (*Cicer arietinum* L.) variety ‘Ujjain 21’ and ‘JG 315’ and they observed that verity ‘JG 315’ gave significantly higher yield as compare to ‘Ujjain 21’. This was due to improvement in yield attributing character such as pod per plants, grain per pod and test weight. Khatun *et al*. (2010) [13] The highest of plant, number of pods/plant, number of seeds/pod and seed yield were observed in BARI Chola-5 and the lowest in BARI Chola-8. Seeds collected at the stage when most of the pods were light brown with a few yellow (H_2 stage) recorded the highest pods/plant, seeds/pod, 1000-seed weight and seed yield. The highest seed yield was recorded from BARI Chola-5 when seeds were collected at H_2 stage. Ray *et al*. (2011) [20] conducted a field experiment at Kalyani in West Bengal for two consecutive years o/2005-06 and 2006- 07 during winter season to study the effect of date of sowing and irrigation regime on seed yield, yield attributes and water use of chickpea. Results revealed that Seed yield of chickpea significantly influenced by irrigation and recorded maximum of 1578.20 kg ha-1 with two irrigations at branching and pod formation stage. Two irrigations at branching and pod formation also recorded significantly higher pods planf1 (40.67), seeds per pod (2.09) and test weight (172.28). Higher AET (actual evapo-transpiration) was recorded with the increasing irrigation frequency, but water use efficiency is not proportional with irrigation level.

Phenology

Verghis *et al.* (1999) [32] studied on the phenolgical development of chickpea (cicer arietinum) in Canterbury, New Zealand using different sowing dates and the duration of all phases was predicted based on thermal time above 4˚C and found the mean accumulated thermal times for the different phases were 133, 447, 761, and 377 °C days for sowing to emergence (S-E), emergence flowering (E-F), flowering to mature pod (F-MP), and mature pod to harvest maturity (MP-HM) respectively. Ahmed *et al.* (2011) [3] conducted a field experiment during *rabi* season at the research field of Gazipur, Bangladesh to evaluate phenology, growth and yield of chickpea (var. BARI Chola-5) in prevailing weather conditions at six sowing dates (November 10, November 20, November 30, December 10, December 20 and December 30). Mainly day lengths and temperatures influenced chickpea phenology, growth and yield. Late sown (beyond November 20) crops received comparatively higher temperatures (20 to 26 ºC) at their reproductive stages making it shorter (38-41 days) than those of the early sown (54-62 days) which received lower temperatures (16 to 25 ºC).

Heat unit requirement

Shivakumar (1986) [24] studied stress degree days (SDD) and canopy-air temperature differential summation procedures were used to quantify the response of crops of chickpea (*Cicer arietinum* L.) to soil water availability and atmospheric demand over a four year period on a deep and medium-deep Vertisol in India using different irrigation treatments and planting dates. Canopy temperatures measured between 13.00–14.00 h provided a good index of the daily mean canopy temperature. Differences in the diurnal variation in the canopy-air temperature differentials between irrigated and non-irrigated chickpea reflected clearly the differential response of the crop to soil water availability. Total water use of chickpea decreased with increasing SDD. Data pooled over three growing seasons showed a close relationship between SDD and yield of chickpea. Calculated water stress index (WSI) which includes the vapor pressure deficit term showed a similar relationship with yield to that with SDD.

Gudadhe *et al.* (2005) conducted a field experiment at Rahuri, Maharastra during *kharif* and *rabi* seasons of 2006-07 and 2007-08. To study phonology and GDD, HTU, HYTU and PTI for cotton and chickpea crops. Result revaluated that mean GDD, HTU, PTU, HYTU and PTI for cotton and chickpea crops were 2478.8, 21171.5, 20209.6, 155392.9, 15.0 and 1855.4, 1232.7, 20687.0, 95667.1, 15.9, respectively. Physiological maturity could be predicted for cotton and chickpea by using GDD, HTU, PTU with R^2 0.99. Singh *et.al*. (2008) conducted a field experiment during *rabi* (winter) seasons of 2004-05 and 2005-06 to study the heat and radiation use of chickpea cultivar in sandy loam soil at Faizabad, (Uttar Pradesh, India). The experiment consisted of three sowing dates *viz.* October 20, November 05 and November 20 with four varieties *viz*. K-850, Awarodhi, Uday and Radhey. Results revealed that sowing on November 05 produced significantly higher yield attributes as well as related higher heat and radiation use efficiencies. Day temperature was highly correlated (R^2=0.79) with dry matter than night temperature. (R^2=0.68).

The highest mean seed yields were obtained with sowing on 45 and 47 SMW. The values of growing degree days (GDD), heliothermal units (HTU) and photo thermal units (PTU) decreased as sowing was delayed. For the different cultivars; GDD varied from 1384 to 1473, HTU ranged from 11177 to 12026 and PTU varied from 15110 to 16244. Tripathi *et al.* (2009) [31] Delay in sowing (November 20) reduced the crop duration by 20 days over sowing done on October 20 and 10 days over sowing done on November 5 with 23.10C.temperature. “K850” was found more conducive for growth and higher thermal unit. Heliothermal unit 16751 (degree days hr) and photothermal unit 22267 from sowing to maturity produced the higher yield of chickpea under agroclimatic conditions of eastern Uttar Pradesh. Chand *et al.* (2010) [6] The number of pods/plant, number of seeds/plant were higher in cultivar KGD 1168 followed by Avrodhi and Radhey. Maximum accumulated GDD (1980.2 day ºC) were utilized by cultivar KGD 1168 while minimum GDD (1916.2 day ºC) utilized by Avrodhi, whereas cultivars K 850 and Radhey were at par to attain physiological maturity. Amongst all the dates of sowing October 25 sown chickpea crop exhibited maximum Heat Use efficiency (HUE) of 1.06 grain kg /ha /deg. day. Singh *et al*. (2012) the accumulated thermal unit during the entire growth period of the crop decreased from 21370 degree days under October 31 sowing to 17850 degree days under late sowing (sowing delayed by 20 days). Number of pods and number of seeds per pod increased with increasing temperature from 9.1-23.5 ^{0}C. Maximum temperature during reproductive stage had negative correlation on the yield. Yield decreased with successive increase of maximum temperature from 27.2-32.

Effect of irrigation and moisture deficit

Davis *et al.* (1999) [7] reported that drought stress under field conditions reduced grain filling duration and the final size of chickpea seeds in the three genotypes in Meoredin, Western Australia. Soltani *et al.* (2006) studied responses to soil water deficit in chickpea (*Cicer arietinum* L.) and evaluated their importance to crop performance under rainfed conditions using a chickpea simulation model in two contrasting locations viz, Tabriz and Gorgan, Iran. Two pot experiments were conducted to determine the thresholds during adrying cycle, when plant responses were monitored as the soil dried progressively. Leaf area expansion and transpiration did not change until the fraction of transpirable soil water (FTSW) reached 0.48 (CL) and 0.34 (CT), respectively, and then decreased linearly to FTSW of 0.03 for leaf expansion and 0 for transpiration. Kumar and Abbo (2001) [14] reported that throughout the world, 90% of the chickpea cultures are rainfed and final dryness is the principal abiotic stress which blocks the production increase.

Kang *et al*. (2008) [11] investigated the effect of irrigation on growth and yield of *Kabuli* chickpea (*Cicer arietinum* L.) and narrow-leafed lupin (*Lupinus angustifolius* L.) at Lincoln University, New Zealand. Irrigation had a marked effect on growth and yield. The results of this study suggested that to achieve their yield potential, crops should be irrigated to replace water deficit over the whole of crop growth. Sadeghipour (2008) [21] conducted an experiment in Tehran, Iran during summer season of 2008 and reported that environmental stresses such as water shortages, especially during grain filling, cause reductions in photosynthesis and remobilization of stored materials, rate and duration of grain filling and grain weight. Patel *et al.* (2009) [18] conducted a field experiment at Navsari, Gujarat during *rabi* season on clay soil to find out the effect of irrigation and land configuration on yield and water use of chickpea. The results revealed that irrigation applied at 0.8 IW/ CPE ratio resulted in significantly higher seed and haulm yield of chickpea over other ratios of irrigation but it remained at par with frequent irrigation at 1.0 IW/CPE ratio. Also there was drastic reduction in water use efficiency with the increase in frequency of irrigation. Ahmed *et al*.(2013) [3] Skipping one irrigation led to significant reduction in all characters under this study in the both seasons (plant height, total dry weight / plant(g), number of branches /plant, number of capsules /plant, dry weight of capsules /plant(g) and dry weight of leaves /plant(g)).

Mustafavi *et al*. (2013) Water stress during reproductive stage caused reduction in leaf chlorophyll content index. In all of the stages of crop growth and development, leaf chlorophyll content index of ILC482 was higher than that of the other cultivars. Grain filling duration, maximum grain weight, grains per plant and grain yield per unit area were significantly reduced by irrigation disruption during flowering and grain filling (I4).

References

1. Agegnehu G, Sinebo W. Drainage, sowing date and variety effects on chickpea grown on a Vertisol in Ethiopia. Arch. of Agro. And Soil Sci. 2012; 58(1):101-113.
2. Agrwal KK, Uadhyay AP. Thermal indices for suitable sowing time of chickpea in Jabalpur Region of Madhya Pradesh. J of Agromet. 2009; 11(1):89-91
3. Ahmed AG, Zaki NM, Magda H, Mohamed MM, Tawfik, Hassanein MS. Growth and Yield Response of Two Chickpea Cultivars (*Cicer arietinum* L.) to Skipping One Irrigation. Middle East J. of Agri. Res. 2013; 2(4):146-151.
4. Anonymous. Hand book of Agriculture. Ind. Council of Agri. Res. New Delhi, 2006, 911-918.
5. Badani H, Katzir I, Gera G. Influence of Sowing Date on Yields of Fresh-harvested Chickpea. J of Agri. Sci. 2010; 2(4):83-88.

6. Chand M, Singh D, Roy N, Kumar V, Singh RB. Effect of growing degree days on chickpea production in Bundelkhand region of Uttar Pradesh. J of Food Legumes. 2010; 23(1):41-43.
7. Davis S, Turner NC, Siddique KHM, Leport L, Plummer J. Seed growth of Desi and Kabuli chickpea (*Cicer arietinum* L.) in a short season Mediterranean-type environment. Aust. J Exp. Agric. 1999; 39:181-188.
8. Gholipoor M. Potential effects of individual versus simultaneous climate change factors on growth and water use in chickpea. Int. J of Pl. Pro. 2007; 1(2): ISSN 1735-6814.
9. Gudadhe NN, Kumar N, Pisal RR, Mote BM, Dhonde. Evalution of agrometiorological indices in relation to crop phenology of cotton (*Gossipium* spp.) and Chickpea (*Cicer aritinum* L.) at Rahuri Region of maharastra. Tre. in biosci. 2013; 6(3):246-250.
10. Kabir AHMF, Bari MN, Karim A. Effect of sowing time and cultivars on the growth and yield of chickpea under rainfed condition. Bangladesh J Agril. Res. 2009; (2):335-342
11. Kang S, McKenzie BA, Hill GD. Effect of irrigation on growth and yield of *Kabuli* chickpea (*Cicer arietinum* L.) and narrow-leafed lupin (*Lupinus angustifolius* L.) Agro. New Zealand. 2008; 38:11-32.
12. Kaya M, Sanli A, Tonguç M. Effect of sowing dates and seed treatments on yield, some yield parameters and protein content of chickpea (*Cicer arietinum* L.). Afri. J. of Biotech. 2010; 9(25):3833-3839.
13. Khatun A, Bhuiyan MAH, Nessa A, Hossain SMB. Effect of harvesting time on yield and attributes of chickpea (*Cicer arietinum* L.). Bangladesh J Agril. Research. 2010; 35(1):143-148.
14. Kumar J, Abbo S. Genetics of flowering time in chickpea and its bearing on productivity in semiarid environments. In: Advances in Agronomy. Elsevier, 2001, 107-138.
15. Mustafavi SH, Golezani G, Kalvanagh JS, Movludi A. Effect of irrigation disruption at reproductive stages on grain filling of chickpea cultivars. Int. J of Agro. and Pl. Pro. 2013; 4(5):863-868.
16. Nagrajaiah KM, Palled YB, Patil BN, Khote AB. Responce of chickpea varieties to seed rate and time of sowing under late sown conditions in malaprabha command area. Karnataka J Agric. Sci. 2005; 18(3):609-612.
17. Parthasarathi T, Velu G, Jeyakumar P. Impact of Crop Heat Units on Growth and Developmental Physiology of Future Crop Production: A Review. Research & Reviews: A J. of Cro. Sci. and Tech. 2013; 2(1):2319-3395.
18. Patel KB, Tandel YN, Arvadia MK. Yield and water use of chickpea (*Cicer arietinum* L.) as influenced by irrigation and land configuration. Int. J of Agri. Sci. 2009, 369-370.
19. Rao DLN, Giller KE, Yeo AR, Flowers TJ. The effects of salinity and sod city upon nodulation and nitrogen fixation in chickpea (*Cicer arietinum* L.). Ann. Bot. 2002; 89(5):563-570.
20. Ray M, Nanda MK, Khan DK. Effect of date of sowing and irrigation on seed yield, yield attributes and water use of Chickpea (*Cicer arietinum* L.) at lower Gangetic plains of West Bengal. J of Crop and Weed. 2011; 7(2):30-32.
21. Sadeghipour O. Effect of withholding irrigation at different growth stages on yield and yield components of mung bean (*Vicia radiata* L. Wilezek) varieties. American Eurasian J Agric Environ Sci. 2008; 4:590-594.
22. Saini SS, Faroda AS. Effect of sowing time, its pattern and seed rate on growth and yield of ‘H86-143’chickpea (*Cicer arietium* L). Ind. J of Agro. 1997; 42(1):645-649.
23. Sharma ML, Chauhan YS, Bhardwaj GS, Sharma RK. Relative performance of chickpea varieties to sowing dates. Ind. J. of Agro. 1988; 33(4):452-454.
24. Shivakumar MVK. Canopy-air temperature differentials, water use and yield of chickpea in a semi-arid environment. Irrigation Science. 1986; 7(3):149-158.
25. Shrivastava SK, Singh R, Chandraswanshi BR. Response of chickpea cultivars under different dates of sowing in Chhattisgarh region of Madhya Pradesh. Int. Chickpea Newsletter. 1990; 23:26-27.
26. Singh AK, Mishra AN, Tripathi P. Thermal regime requirement and plant responses of chickpea cultivars under variable weather conditions. J. of Agromet. 2012; 14(1):67-69
27. Soltani A, Hammer GL, Torabi B. Modeling chickpea growth and development: phenological development. Field Crop Res. 2000; 99:1-13.
28. Summerfield RJ, Hadly P, Roberts EH, Minchin FR, Rawsthorne N. sensivity of chickpea (*Cicer arietinum* L.) to hot temperature during the reproductive period. Expt. Agric. 1984; 20:77-93.
29. Swan JB, Schneider EC, Moncrieff JE, Paulson WH, Peterson AE. Estimating crop yield and grain moisture from air growing degree-days and residue cover. Agron. J. 1989; 79:53-60.
30. Thakur HS, Sinha NK, Raghuwanshi RKS, Sharma RA. Response of gram (*Cicer arietinum*) varieties to plant population and date of sowing. Indian J. of Agro. 1998; 43(2):315-317.
31. Tripathi P, Singh AK, Sheobardan, Adhar S. Growth and thermal unit of chickpea (*Cicer arietinum* L.) genotypes under variable weather conditions of Eastern Uttar Pradesh. Asian J. of Envir. Sci. 2009; 3(2):164-168.
32. Verghis TI, McKenzie BA, Hill GD. Phenological development of chickpea in Canterbury. New Zealand J. of Crop and Hort. Sci. 1999; 27:249-25.