Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 450-452
Received: 15-05-2018
Accepted: 20-06-2018

Impact of seasonal climatic variability on production and productivity of crops

Seema Dahiya, Charul Chaudhary, VS Hooda, Suryapal Singh, Meena Sewhag, Rajbir Singh Khedwal and Sourabh

Seema Dahiya
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Charul Chaudhary
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

VS Hooda
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Suryapal Singh
Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar, Haryana, India

Meena Sewhag
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Rajbir Singh Khedwal
Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab, India

Saurabh
Department of Horticulture, CCS Haryana Agricultural University, Hisar, Haryana, India

Correspondence
Suryapal Singh
Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar, Haryana, India

Abstract
In the face of climate change, understanding climatic impacts on crop production is essential for identifying solutions, which will improve current food production and for increasing the adaptability of these systems in the future. The aim of this paper is to evaluate the impact of seasonal climatic variability on crop yield. Consequently, recommendations will be made to help ameliorate the current agricultural production systems in an effectual and efficient adaptation to future climate variability.

Keywords: climate change, temperature, radiation, rainfall and crop productivity

Introduction
Cropping is practiced over a broad range of agro ecosystems, field crops being produced in climates ranging from very hot to very cold, and from very wet to really dry, over temperate, tropical and semi-arid zones. Crops products and yields are mainly dependent on light, temperature, moisture and carbon dioxide (CO2) concentration. However, the levels of these climate inputs, especially rainfall, vary between locations and years, in part due to climate variability. Temperature and water supply also vary over the long-term, including in response to climate change, with major implication for crop yield. Climate and management also affect the incidence of insect, pests and diseases, which in turn have an influence on crop yields and quality of produce and producer's costs and returns.
Climatic factors are key determinants to crop production processes; solar radiation, rainfall and temperature fluctuations lead to water shortage, rising tide, altering soil moisture content, pest and disease occurrence that restrict crop growth and can account for 15 - 80% of the deviation of inter-annual yield resources (Oerke *et al*., 2012 and Gommes *et al*., 2010) [6, 3]. India has the highest climatic variability of any continent in the world. Therefore, it is extremely benificial for studying the major determinants of climate on crop productivity.

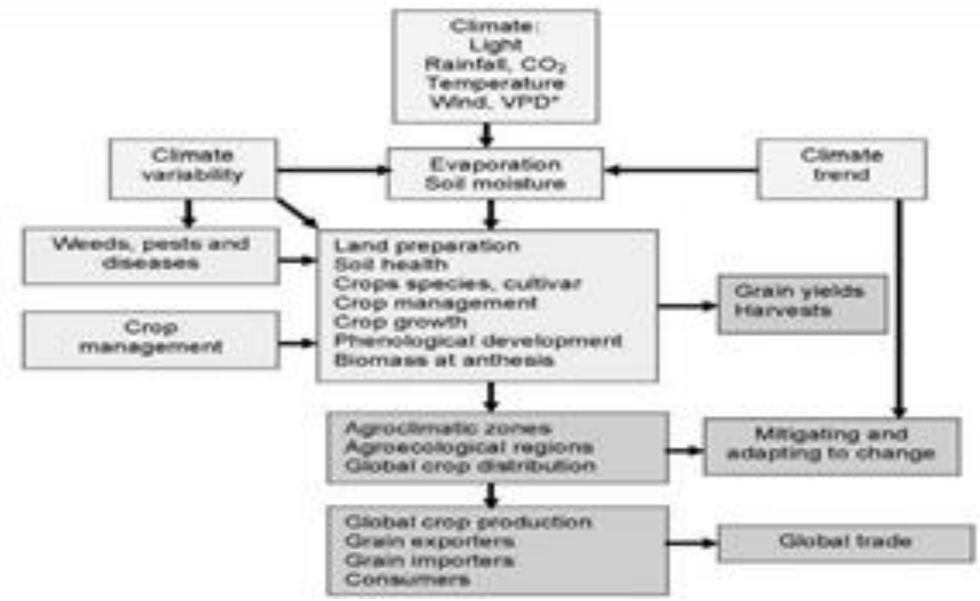

Fig 1: Climate impact on the agricultural sector *VPD = Vapor pressure deficit

In this paper, we concentrate on the climatic determinants of crop productivity by first taking into account how the climate envelopes of different crops based on light, temperature and moisture control the distribution of cropping and other land uses around the world. We also discuss how these climatic variables influence the growth and development of crops, inter-annual deviation in grain yield and associated risks (Figure1). Cropping in a variable climate presents many challenges, predominantly in the more arid part of the globe, so ways of reducing losses in adverse seasons should be consider.

Major climatic determinants of plant productivity

1. Temperature

Temperature mainly indicates the heat concept of a physical structure. It shows the intensity of heat energy or degree of hotness or coldness. Temperature mainly effects the plant activities that governs the mechanisms of hormones, genes etc. Temperature affects from sowing of crops to final yields with various degree. The growth and development of plant occurs in the range of about 0 to 35 ^{o}C Within most of this range, with every 10 ^{o}C rise in the temperature, increases the growth by 2-3 times. There are three temperatures known as the cardinal points for growth, the minimum or the lowest temperature at which growth can be noticed; the optimum or temperature of maximum range of growth; and the maximum or the highest temperature at which growth can be noticed. The values for three cardinal temperatures differ from plants of arctic, temperate and tropical zones. The optimum temperature for growth may be varying for a particular plant and also for a particular stage of development of the same plant. The growth depends on other important physiological processes such as photosynthesis and respiration and these processes also have their cardinal temperatures. Higher temperature can be expected to produce a more deleterious effect on net photosynthesis than lower temperatures, contributing to diminished production of photosynthates above a certain temperature.

2. Sunshine and Radiation

Solar radiation is the principal sources of energy for various agricultural purposes. Out of total spectrum, the visible part of spectrum to (0.4 to 0.7 u) contributing about 45% of the total global radiation, which affects a number of plant functions and controls the plant growth and developments.

Significance of Light

Although growth of higher plants ultimately depends upon photosynthesis, light as such is not necessary for the process of plant growth and development as long as adequate amount of organic materials are available. Some plants can complete their life cycle in the dark e.g. tuberous or bulbous plants. The higher plants grow in dark show a weak growth known as etiolation. Usually the leaves remain free of chlorophyll and so the color is pale yellow, although some ferns, gymnosperms, seedlings and algae can manufacture chlorophyll in the dark. Light quality, duration and intensity influence plant growth and development to varying level in different plants.

Quality

Quality of light indicates the wavelength of radiation. Full range of visible spectrum of light is needed for the normal growth and development. Flowering in case of long day plant is restrained by red light with 0.66u. Red portion of the light stimulate germination. Stem elongation is promoted by far red. Germination of seed is inhibited when exposed to green, blue and infra-red portion of the spectrum. Blue violet light increases the intermodal growth while green light reduces the expansion of leaves as compared with complete spectrum of visible light. Red light stimulates growth. Infrared and ultraviolet lights are unfavorable to growth.

Duration

Duration of light extremely affects vegetative as well as reproductive growth. The initiation and suppression of flowers are dependent on duration. Based on flowering behavior to the photoperiod, plants can be categorized as long day, short day and day neutral plants. Weakness of moon light in red wavelength, most effective wavelength for photoperiodism, confined its role as flowering factor to some kinds of plants only. It also induces other effects like inculcation and breaking of bud dormancy and winter hardiness.

Intensity

Light intensity affects growth through its effect on photosynthesis. The rate of photosynthesis increases logarithmically with the increasing light intensity. But there occurs a point at which further increases in light intensity will not increase photosynthesis known as light saturation intensity. It value is higher for tropical crops than for temperature crops. Higher the temperature, higher is compensation point (The minimum light intensity at which respiration equals photosynthesis rates). Weak light induces shortening of internodes and expansion of leaf. Very weak light decreases the rate of overall growth and also the photosynthesis. Development of chlorophyll depends upon light and in its absence etiolin compound is produced which imparts yellow colour to the plant. Similarly high light intensity indirectly hastens the rate of water loss and diminishes the rate of growth.

3. Rainfall

The most important climatic factor for agriculture is the rainfall. In agriculture, rainfall mainly manifest itself through its effect on the edaphic factors, viz., soil moisture, soil temperature and aeration. Rainfed crops directly depend on rainfall. The water source such as rivers, tanks and wells, which supply water for irrigation also depend on the rain. Rainfall during the flowering and grain-filling period is very detrimental. Rainfall within six hours of foliar sprays negatively affects the efficiency of chemicals. Heavy rains cause soil erosion and leaching of nutrients, which leads to mineral deficiency in plants. Excessive rainfall occurring during vegetative and flowering phase may delay tillering and reduce production. Poor rainfall causes drought and limits the crop growth and production. Rain causing regular wetting of leaves encourage growth of bacteria on leaf surfaces.

Impact of seasonal climatic variability on some of the important crops

A. Cereals

1. Effect on rice and wheat yield

Chung *et al*. (2015) [2] indicated that seasonal average rainfall, average maximum temperature, and average minimum temperature had significant effect on rice yield. While, they found that the seasonal average rainfall factor had a positive relationship with rice yield and that the seasonal average maximum temperature affected adversely on rice yield of the two growing seasons (Summer-Autumn and Winter Spring). In addition, rice yield in the Summer-Autumn (SA) season did not relate to seasonal average minimum temperature. This climate variable had positive impact on Winter Spring (WS) rice yield at statistical significant level. Lobell *et al.* (2011) [5] estimated that climate change from 1980 to 2008 has already reduced global production of maize by 3.8% and wheat by 5.5 % relative to a counterfactual without climate change. Umesh *et al*. (2007) [8] studied the effect of location, season and staggered sowing on seed quality attributes of sunflower cv. RSFH-1 during kharif and rabi season of 2003-04 at Dharwad and Bagalkot locations. Significantly higher seed germination, vigour index, germination rate index and oil content were recorded at Bagalkot location. Similarly, all these quality parameters were better during rabi than kharif season.

B. Pulses

1. Effect on gram

Barua and Barua (2000) studied the seasonal (summer and *kharif*) effect on seed yield and quality in seven green gram varieties and revealed that varietal effects and their interaction showed significant differences for most of the seed yield and quality characters. The seasonal effect was more prominent than the varietal effect on seed yield and quality. The summer crop was better than the *kharif* crop for seed yield and germination percentage.

2. Effect on mungbean

Saha *et al* 2004 [7] observed the seasonal variation in seed quality of two improved mungbean varieties *i.e*. BARImung2 and BUmug which were tested in kharif I (March- May) and in kharif II (August- November) seasons. Seed quality in terms of germination parallel to the pattern of seed growth and it was almost 100 percent at its maximum dry weight. Seasonal variation indicated that better quality mungbean seeds were harvested in kharif I season from BUmug 2.

C. Vegetables

1. Effect on chilli

Kanwar *et al*. (2004) [4] studied the effect of planting date (winter, spring or summer) on the seed quality of 15 chilli cultivars at Ludhiana, Punjab, during 1999-2000 and concluded that plants grown in winter had the maximum test weight, whereas those grown in spring season had the highest seed germination percentage and seed vigor index. The interaction between planting season and genotype was also significant for seed germination and seed vigor.

2. Effect on okra

Singh *et al*. (2010) [9] conducted a experiment in Uttar Pradesh, India, with three cultivars of okra namely Arka Anamika, Parbhani Kranti and Varsha Uphar, in two growing season, i.e. summer and rainy during 2005-06 and concluded that seed quality in both season crop had at par performance, having 580.56 and 575.33 seedling vigour index, 93.44 and 92.33 per cent seed germination, respectively, in summer and rainy season. The interaction between planting season and genotype was found non-significant for seed yield and quality.

Conclusion

It is clearly that crops yield and food are linked to climate variability trends. Hence, it is necessary to invest in agricultural research and development in order to provide farmers with more drought-tolerant, storm-tolerant crop varieties, and educate those farmers with effective production practices, which are efficient and resilient in various climate conditions. Moreover, the consideration of enhancing or perfecting techniques required to advance the seasonal climate forecasts while simultaneously disseminating current climate conditions and predictions are a needed requirements to help sustain, improve and boost the agricultural development in the country.

References

1. Barua M, Barua PK. Seasonal effect on seed yield and quality in greengram. Seed Research. 2000; 28(2):153-157.
2. Chung NT, Jintrawet A. Pro. Mburom. “Impacts of Seasonal Climate Variability on Rice Production in the Central Highlands of Vietnam Agriculture and Agricultural Science Procedia. 2015; 5:83-88.
3. Gommes R, Challinor A, Das H, Dawod MA, Mariani L, Tychon B. *et al*. Guide to Agricultural Meteorological Practices. World Meteorological Organization. 2010, 134.
4. Kanwar JS, Bhuvaneswari G. Chilli seed quality as influenced by genotypes and planting seasons. Seed-Research. 2004; 32(2):217-220.
5. Lobell DB, Schlenker W, Costa-Roberts J. Climate trends and global crop production since 1980. Science. 2011; 333:616-620.
6. Oerke EC, Dehne HW, Schonbeck F, Weber A. Crop Production and Crop Protection: Estimated Losses in Major Food and Cash Crops. Elsevier, 2012.
7. Saha RR, Hamid A, Haque M. Seasonal variation in seed quality of two improved mungbean varieties. Improving-income-and-nutrition-by-incorporating-mungbean in cereal fallow in the Indo-Gangetic Plains of South Asia DFID Mungbean Project for 2002-2004 Proceedings of the final workshop and planning meeting, Punjab Agricultural University, Ludhiana, Punjab, 2004, 35-43.
8. Umesh VC, Ravi hunje TA. Malabasari HL, Nadaf, BS vyakarnahal. Influence of Provenance on Seed Quality in Sunflower Hybrid RFHS-1. Karnataka J Agric. Sci. 2007; 20(2):265-268.
9. Singh P, Swarnkar SK, YadavVK, Srivastava A. Influence of sowing seasons on seed yield and quality of okra (*Abelmoschus esculentus* L. Moench) varieties. Progressive- Agriculture. 2010; 10(1):180-181.