Sugarcane and it’s impact of Indian Climate Change

Nitesh Dogne¹

Abstract

India is the world’s second largest producer of sugar after Brazil with an average annual production of 25.1 million tones, with about 5.1 million ha area under cane cultivation and its processing for value added products such as sugar, jaggery, bio-ethanol, paper, bio-fertilizer, power cogeneration etc. has drawn awareness because of its socio-economic impact and environmental concerns. Droughts have plagued the earth for centuries. Climate change will significantly affect the sustainability of watersupplies in the coming decades. As parts of the country get drier, the amount of water available and its quality will likely decrease - impacting people’s health and food supplies. Changes in precipitation and water availability could have serious consequences for commercial agriculture – crop yields and food security suffer. Cultivation of sugarcane in India dates back to the Vedic period. The earliest mention of sugarcane cultivation is found in Indian writings of the period 1400 to 1000 B.C. It is now widely accepted that India is the original home of Saccharum species. Saccharum barberi and Polynesian group of island especially New Guinea is the centre of origin of S. officinarum. The Study shows how sugarcane impact the Indian climate change.

Keyword: Sugarcane, Climate, India, Management, Consumption

Introduction

India is the second largest sugarcane producing country after Brazil. Largest sugarcane producing state of India is Uttar Pradesh, which has 38.61% share in overall sugarcane production as per 2013-14 figures. The second and third largest states are Maharashtra and Karnataka. Other main sugarcane producing states of India include Bihar, Assam, Haryana, Gujarat, Andhra Pradesh and Tamil Nadu is the second largest sugarcane producing country after Brazil. Largest sugarcane producing state of India is Uttar Pradesh, which has 38.61% share in overall sugarcane production as per 2013-14 figures. The second and third largest states are Maharashtra and Karnataka. Other main sugarcane producing states of India include Bihar, Assam, Haryana, Gujarat, Andhra Pradesh and Tamil Nadu. In India, sugarcane is produced in both tropical and subtropical regions. There are three distinct geographical regions in which sugarcane is produced. These are: Satluj-Ganga plain from Punjab to Bihar containing 51% of the total area and 60% of the country’s total production. The black soil belt from Maharashtra to Tamil Nadu along the eastern slopes of the Western Ghats Coastal Andhra Pradesh and Krishna river valley. We note here that sugarcane gets more or less ideal condition for its growth in the tropical regions.

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Figure 1. Sugar cane production in India (2004-2010)
Source: Ministry of agriculture: Farmer Portal

Figure 2. Indian map showing sugarcane production
Source: Ministry of agriculture: Farmer Portal
Climatic and Requirement

Climatic requirement Temperature for different critical stages of sugarcane: The different critical stages are germination, tillering, early growth, active growth and elongation. Optimum temperature for sprouting (germination) of stem cuttings is 32° to 38°C. It slows down below 25°, reaches plateau between 30°-34°. Temperatures above 38° reduce the rate of photosynthesis and increase respiration. For ripening, however, relatively low temperatures in the range of 12° to 14° are desirable. Reduction in yield of sugarcane due to rise in temperature: The sugarcane productivity and juice quality are profoundly influenced by weather conditions prevailing during the various crop-growth sub-periods. Sugar recovery is highest when the weather is dry with low humidity; bright sunshine hours, cooler nights with wide diurnal variations and very little rainfall during ripening period. These conditions favour high sugar accumulation. The climatic conditions like very high temperature or very low temperature deteriorate the juice quality and thus affecting the sugar quality. Favourable climate like warm and humid climate favour the insect pests and diseases, which cause much damage to the quality and yield of its juice and finally sucrose contents. (www.sugarcanecrops.com).

Brain Storming on 24th March, 2009 at IISR, Lucknow: A brain storming discussion was held in IISR, Lucknow to improve sugarcane production and sugar recovery in India with emphasis on UP and Maharashtra under the Chairmanship of Dr. S.P. Tiwari, DDG (CS &Edn.) on 24th March 2009. In the session the following points were set for low productivity and sugar recovery: 1. Monoculture of sugarcane i.e. lack of crop rotation in some areas, leads to deletion of nutrients in soil and adversely affect cane productivity. 2. Cultivation of rejected and unapproved varieties not only leads to low cane productivity, but also pose a risk to buildup of diseases, particularly red rot. 3. Ratoon crop is generally receives much less attention and care by the cane growers leading to lower cane productivity. 4. Post harvest deterioration in cane quality on account of staling and delayed crushing contributes to low sugar recovery. 5. Inadequate availability of quality seed of new sugarcane varieties and poor seed replacement rate adversely affect the realization of potential cane yield of varieties. 6. Increasing problem of soil compaction/ hard pan coupled with inadequate sub soiling not only adversely affects plant growth, but also promotes lodging of canes. 7. In U.P. rainfall in the month of May and June 2008, coinciding with the tillering phase in sugarcane, adversely affect tillering which led to lesser number of millable canes. Due to continuous rains, fertilizers could not be applied on time. 8. These factors coupled with shortage of phosphatic and potassic fertilizers, particularly in UP,

<table>
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<tr>
<th>State</th>
<th>Area</th>
<th>Production</th>
<th>Productivity</th>
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<tbody>
<tr>
<td>UP</td>
<td>2.10</td>
<td>124.8</td>
<td>59.4</td>
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<tr>
<td>Maharastra</td>
<td>0.52</td>
<td>41.8</td>
<td>81.0</td>
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<td>TN</td>
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<td>26.9</td>
<td>99.3</td>
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<tr>
<td>Karnataka</td>
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<td>21.9</td>
<td>85.9</td>
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<tr>
<td>AP</td>
<td>0.20</td>
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<td>75.1</td>
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<tr>
<td>Punjab</td>
<td>0.17</td>
<td>11.0</td>
<td>63.8</td>
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<tr>
<td>Gujarat</td>
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<td>Haryana</td>
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<td>Bihar</td>
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<td>6.3</td>
<td>45.2</td>
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<tr>
<td>MP</td>
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</tr>
<tr>
<td>India</td>
<td>3.96</td>
<td>265.0</td>
<td>66.9</td>
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led to low cane productivity. 9. Relatively higher minimum
temperature and higher relative humidity during maturity
phase delayed sugarcane ripening resulting in low sugar
recovery. Moreover, crushing of immature cane due to
imbalance crushing schedule lowered sugar recovery. 10. In
Maharashtra, low rainfall and inadequate water availability
during grand growth phase together with shortage of fertiliser (DAP), labour and power resulted in reduced
cane productivity. 11. Area under early maturing high
sugar varieties is very less which led to low average sugar
recovery. Recommendations of the National Seminar on
“Mechanization of Sugarcane Cultivation” held at IISR,
Lucknow on March 19-20, 2010. After deliberations,
following recommendations/Action Plan emerged for spread
of mechanization in sugarcane cultivation: 1. Plan to be
prepared by the sugar mills for mechanical planting in their
respective area in the initial stage and subsequently more
operation could be included. 2. Identifying the machine
and source of supply in consultation with IISR, Lucknow,
if required. 3. Manufacturer selected should ensure the
quality control for which he shall send prototype to IISR
for performance testing, if desired. This quality will have
to be maintained by him in future supply. 4. Manufacturer
will provide working design of the supplied equipment and
will ensure after sale service during the use period. 5. IISR
may provide training to the manufacturers and the users
at their cost for the proper operation and maintenance of
the equipment. 6. Any suitable device pertaining to the
sub-soiling through RMD/Sub-soiler should be used to
improve soil health and ratoon productivity. For this also
sugar factories should plan in advance. 7. Initially, DSCL and
Balrampur group of Industries have agreed to initiate this
plan in their areas of operations. 8. Group meeting may
be arranged in future to take stock of the progress made
in this regard.

Effect of Climate Change on Sugarcane

It general, agricultural production activities of all the
sectors are the most sensitive and vulnerable to climate
Srivastava & Rai – Impact of climate change on sugarcane
clearly reports that the climate change is real and the
process is going on. Its impact will be disproportionately
on developing countries threatening to undermine the
achievement of the Millennium Development Goals,
reduction of poverty and security of safeguard food.
The climatic change is not only concerned with the crop
production, instead, heavy impact on socio-economic set-
up of a region, ultimately affecting the national economy.
The change also poses significant challenges for the fair
trade movement. There are evidences that most of the
small farmers in Indian subcontinent, as well as others
of Southeast Asia, are experiencing increased climate
variability and change. It is expected that climate change
will include more extreme events and slow onset impacts,
such as changes in precipitation and temperature (Nelson
et al. 2010). Climate change is likely to have mainly negative
impacts upon agricultural production, food security and
economic development, especially in developing countries
(Hannah et al. 2005). Sugarcane is also strongly influenced
by the impacts of long-term climatic change as well as
local weather and seasonal variations. The climate affects
the growth and development of plants and may harm
the crops. It also affects severely on the microorganisms
related directly or indirectly for better growth and yield
of the crop. Rosegrant et al. (2008) identified potential
direct effects of climate change on the agricultural systems
which are as follows: (i) Seasonal changes in rainfall and temperature could impact agro climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease populations, etc. (ii) Transpiration, photosynthesis and biomass production is altered. (iii) Land suitability is altered. (iv) Increased CO2 levels lead to a positive growth response for a number of staples under controlled conditions, also known as the “carbon fertilization effect”. Certain model-based predictions of climate change on various regions of the globe have been made by Rosegrant et al. (2008), which are as follows: (i) Global models consistently highlight risk disparities between developed and developing countries. 

(ii) For temperature increases of only 1-2°C, developing countries without adaptation will likely face a depression in major crop yields. (iii) In mid-to high latitudes, increases in temperature of 1-3°C can improve yields slightly, with negative yield effects if temperatures increase beyond this range. (iv) Stronger yield-depressing effects will occur in tropical and subtropical regions for all crops, which reflect a lower growing temperature threshold capacity in these areas. (v) Estimations predict that cereal imports will increase in developing countries by 10 to 40 percent by 2080. (vi) Africa will become the region with the highest population of food insecure, accounting for up to 75 percent of the world total by 2080.

![Figure 4. Arrears - the link to induced cyclicality](source: KPMG Research)

**Insect/ Pest control**

Insects and pests are equally dangerous if not controlled within time. Sugarcane is also very much susceptible to the same and may bear heavy loss due to rapid and enormous growth of the pests in comparatively short time depending upon climate, rain fall, temperature, as well as sufficient food material in the form of crop itself. More than 200 species of insects are known from India, however, a few are considered as most devastating. Some of the common insects of the sugarcane, its time of appearance and controlling measures are as follows: Pyrillaperpusilla. It is a most destructive foliage- sucking pest and causes heavy loss in cane yield and sugar recovery. It appears in the months of August-September after heavy rainfall casing high humidity. It attacks mainly on the leaves and leave sheath. Spray of chemicals is the only remedy. Planting in paired row method provides space for supervision and to undertake control measures (Paul 2007). These are the underground insects attack the stalk used for the planting as well as shoots, canes. In initial phase, it finds the way from the cut ends of the seed and damage the soft tissue leading to low bud germination and replantation. These include Coptotermesheimi, Odontotermesassmuthi, O. Obesus, O. Wallonensis, Microtermesobesi and Trinervitermesbiformis. They are most active under draught conditions, i.e. April-June and October, however, active in almost all the seasons. Farmers control termites by spraying pesticides over the stalks in the furrow during planting (Cheavegatti-Gianotto et al. 2011). The remedial measures include application of well rotten farmyard manure, removal of stubbles and debris of previous crop, addition of chemicals in the furrows during planting. Borers. These are the insects which bore young shoots, canes and roots. Significant damage results from the sugarcane borer larvae tunneling within the stalk. This can cause a loss of stalk weight and sucrose yield. The borer’s tunneling into the stalk allows points of entry for secondary invaders. If the tunneling is extensive, death of the terminal growing point of the plant may result. Weakened stalks are more subject to breaking and lodging (Cherry et al. 2001). The shoot borers (Chiloinfuscatuscellus) attacks in the early phase during the months of plant growth.
i.e. April-June by entering laterally through the holes in the stalk and may even damage complete cane by upward or downward boring producing dead hearts. In early phase, it may damage the mother stem destroying entire stem. Plantation of early crop e.g. before mid March is suggested. Chemical treatment is effective.

Disease Management

There are about 50 diseases of sugarcane caused by fungal, bacterial, viral and phytoplasm pathogens (Vishwanathan and Padnabhan 2008). Fungal diseases include Red rot, Smut, Wilt, Eye spot, Yellow spot, Brown spot, Pine apple, Banded sclerotial and Pokkahboeng, whereas Ratoon stunting, Leaf scald and Red stripe are mainly caused by bacteria. Viral and mycoplasmal diseases are Mosaic, Grassy shoot and Leaf yellow of sugarcane. Brief ideas about the symptom of important diseases are as follow: Red rot. It is a fungal disease caused by Colletotrichum falcatum. The growth of this fungus is affected by temperature, pH, nutrition and environmental conditions. It is one of the main diseases of Indian subcontinent as well as other parts of the world. It can attack entire plant e.g. stalk, leaf, buds or roots however: the most amazing phase is its attack on stalk. The symptom depends on the susceptibility of the sugarcane variety, time of infection and the environment which may not be apparent in the initial phase but may be fatal in later stage. In the initial phase, the infected tissues show dull red coloration with whitish patches across the stalk. These white patches differentiate it from other stem rots. In resistant varieties, the infection is largely confined to the internodes. The typical stalk symptoms i.e. presence of white spots in otherwise rotten (dull red) internodal tissues and nodal rotting appear when the crop is at the far end of the grand growth phase during August-September in subtropical India. In the early stages of infection, it is difficult to recognize the presence of the disease in the field, as the plant does not display any external symptom or distress. At a later stage, some discoloration of rind often becomes apparent when internal tissues have been badly damaged and are fully rotten. At the field level, this may be observed as the death of a few plants or clumps to the failure of entire crop (Duttamajumder, 2008). Infected leaf shows small red marks on upper surface of the lamina and midrib. Due to this disease, retardation in the yield and deterioration occurs in juice quantity. The management includes selection of healthy sets treated with heat therapy: cultivate of resistant sugarcane varieties, burning of trash and other residue of the field, rotation of with paddy, onion, garlic, linseed and green manure crops etc. Precaution should be taken to control the spread of disease through water: hence, water of infected crop field is not to be allowed in other crop grown areas.

Irrigation management

Sugarcane is a high water requirement crop. The lack of water in soil causes the moisture stress which can influence the crop from the very beginning and up to the last. Reduction in the stalks elongation and leaves in the plant are the primary symptoms of water stress, whereas, the last phase of crop shows decrease in sucrose accumulation. Irrigation is therefore a major factor for growth of sugarcane which has been a matter of active research from the very beginning and will probably continue with more quantum in future as the water is being expansive day by day, so as to the cost of irrigation.

Innovation

Farmers Innovation (Suresh Desai) 75% water reduction, without use of chemicals and pesticides. 40 tonnes per acre can be raised to 60 tonnes. Only 300 members in his club with approximately 1,500 acres of land.
Conclusion

Various climatic factors and agronomic measures required for better growth of sugarcane are specific in local set-up. The change in global climate is a matter of serious concern to sugarcane cultivators for sustainable development of the crop. A review of various climatic factors and agronomic measures strongly suggests for the adaptation of modern techniques being developed at regional level in most of the sugarcane producing areas. In the initial phase, both land preparation and planting material need a careful planning as the further growth of the crop entirely depends on the same. Land preparation requires a thorough study of the soil and climatic conditions of the region which may vary as per the temperature of the region, availability and intensity of rainfall and sun light. The selection of planting material is being suggested for those varieties which can sustain local climatic conditions as well as resist for pests and diseases. Since, sugarcane is a long standing crop and experiences severe changes in climate, biotic and abiotic factors, therefore, a regular care of soil and nutrient management, pest control, disease management and adequate irrigation are required. It is also advised to the cultivators to take suggestions of the experts to enhance the quality and production of the cane. Such expertise are made available locally by government at agriculture offices and research centers. Besides, all most all the agriculture universities, colleges and research institutes extend their cooperation to the cultivators for good development of crops including sugarcane. The same may be availed regularly to ensure good crop.

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