



IMPACT OF PLANT GROWTH REGULATORS AND CHEMICALS ON GROWTH AND YIELD OF SUGARCANE

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ABSTRACT

Sugarcane crops accomplish the primary need of the world for sugar. Sugarcane is exposed to various biotic and abiotic factors from germination to the maturation phase, which affects its growth and development and ultimately yields. Every crop regulated its growth and development stages with plant growth regulators (PGR's). These are the natural substances and their synthetic analogs, which at low concentration promote, inhibit or qualitatively modify or regulate any physiological process in plants. The sets of sugarcane treated with ethylene and calcium chloride will improve germination percentage and better establish buds. During the formative phase of the crop, the application of GA₃ increased photosynthetic efficiency, leaf area index, dry matter accumulation, the sugar content of sugarcane, and promote root respiration and metabolism. At the grand phase of the sugarcane crop, brassinolide spray significantly boosts the growth attributes of sugarcane. During the maturation phase of the sugarcane crop, the spray of polaris and sodium metasilicate chemicals alter the sucrose content in sugarcane juice, and for early and uniform maturity of the crop, the balsario chemical can be used.

INTRODUCTION

The global production of raw sugar is 172 million tons, and more than 70 percent of total sugar produced in the world is obtained only from sugarcane. India is world's second-largest sugar-producing country. At present, sugarcane is cultivated in more than 30 mha in over 80 countries, and recently, the sugarcane grown area in India is pegged around 5.25 million hectares. Uttar Pradesh has the largest area (22 lakh ha), with around 50 percent sugarcane growing area, followed by Maharashtra, Karnataka, Bihar, Gujarat, etc Tamil Nadu, and Haryana. Uttar Pradesh is the country's leading sugar-producing state, followed by Maharashtra and Karnataka, but productivity-wise, Tamil Nadu leads with over 100

tons per hectare, followed by Karnataka Maharashtra. Among the major sugarcane growing areas, the lowest productivity recorded from the Bihar. Sugar is the second largest agro-based industry in the country, supersede by the textiles industry.

SUGARCANE GROWTH AND DEVELOPMENT STAGES

Sugarcane crop undergoes four phases during its life cycle. After 60 days of germination, tillering occurs from April to June month in India, which requires a high temperature, clear sky, and longer photoperiod. In successive years of planting sugarcane in the same fields, it is observed that the yield of the sugarcane crop reduces due to the shortening of the internodes. This internode shortening may be reduced by application of plant growth regulators, increasing yield and improving quality.

Among the various growth and development parameters, tillering is important. Tillering or developing secondary shoots is a beneficial characteristic of a variety as it enhanced the number of stalks for a good yield. Tillering also increases the rate of canopy spread which aids in weed control. Varieties may be differing greatly in their tillering capability and the ultimate number of millable cane present at harvest. Besides varietal differences, numerous other factors influence tillering. Tillering is connecting to the phenomenon of "apical dominance" and, therefore, plant hormones play a key role in tillering. The major external factors that influence tillering are light, temperature, nutrition, moisture, and spacing. The early tiller mortality with increasing tillering in ratoon crops is due to heavy competition for nutrients among the tillers in the early stages of sprouting of tillers. Plant growth regulators (PGRs) may increase or decrease the plant growth.



PHASES OF SUGARCANE

- 1. GERMINATION PHASE:** This phase up to 60 days after planting, and during this stage, weed control is an important practice. To promote early growth and better establishment of buds, Ethylene and Calcium chloride can be used. The bud chips from a commercially cultivated sugarcane variety scooped out from freshly harvested sugarcane stalk. The bud chips were instantly sunken in freshly prepared aqueous solutions containing ethephon (0.1 g dm^{-3}) or calcium chloride (1 g dm^{-3}) for 24 h at room temperature ($25 \pm 1^\circ\text{C}$). Treatment with growth-promoting chemicals improved the sprouting of bud chip seed stocks, ranging from 32 to 36% due to ethephon and calcium chloride treatment.
- 2. FORMATIVE STAGE:** The duration of this phase is 60-130 days after planting. Tillering occurs during this phase. The crop has heavy water requirements at this stage in north India. Gibberellin can alter the physiological functions of sugarcane, improve the carbon oxidation of plants. The synthesis of GA_3 increased photosynthetic efficiency and leaf area index, promoting root respiration and metabolism, and increasing dry matter accumulation. During the application of gibberellin, potassium dihydrogen phosphate can mixed in solution. At the time of application, the weather should be clear, and the prepared liquid should be used at one time to prevent degradation. Two to three sprays of gibberellic Acid (0.001%L), i.e., First spray 40-45 DAP; Second spray 70-80 DAS at the rate of 0.018gm or 180 ml in 450-500 Liter water, is suggested for better growth of cane. Various experiments showed that spray of gibberellin in sugarcane could increase the stalk by 5-10cm, plant height by more than 15%, growth rate by 18%~20%, and ultimately yield by 15%—20%. The sugar content of sugarcane was increased by about 5%. At present, the technology of using gibberellin has been widely exploited for sugarcane production.
- 3. GRAND PHASE:** This phase extended between 130-250 days after planting. During this phase, elongation of the internode takes place. The water requirement of the crop is high at this stage in north India. Brassinolide is used to promote sugarcane growth, increase the effective stem number, increase the stem length, stem thick, stem weight, increase sugarcane yield, and sugar content have a significant effect.
- 4. MATURATION PHASE:** The duration of this phase is 250-365 days after planting. Climatic factors, crop duration, variety location-specific integrated nutrients, pest management, and water management are important factors that affect the yield of sugarcane. For uniform maturity, chemical Balsario @4.5 kg per hectare in 1000 liters of water spray may be applied. It also enhances maturity 6-8 weeks

earlier. Chemical ripeners such as Polaris and Sodium metasilicate improve the sucrose content in sugarcane juice when spraying on foliage 6 weeks before scheduled harvesting.

To improve the yield and quality of sugarcane, compounds of sodium nitrate of phenol may be used. For activation of cell activity and increase metabolism sparing of 1.8% sodium phenol sodium hydroxide is effective in sugarcane. The combined application of sodium phenol sodium hydroxide with gibberellin can improve the yield and quality of sugarcane. Gibberellin spraying @ 40-50 mg L⁻¹ twice is suggested by the researchers. The use concentration of gibberellin and sodium nitrate was calculated correctly, especially in polyphenol sodium. In the mixture of gibberellin and sodium nitrate, 2% potassium dihydrogen phosphate can be added. It is helpful to promote the extension of sugarcane and increase the sugar content. Compound multiple azole composite multi-effect azole also contains a variety of crop growth and development necessary trace elements.

Table. 1 Application of PGR's and Chemicals

Name of PGR/chemical	Time of application / No. of Spray	Application conc. Dosage per ha	Purpose
Ethylene	As setts treatment overnight soaking	100 ppm <i>ethrel</i> solution or ethephon (0.1 g dm ⁻³)	Improve germination and tillering
Calcium chloride	As setts treatment overnight soaking/24 hr at room temperature	1 g dm ⁻³ calcium chloride solution	Improve germination
Gibberellin	a) First spray 40-45 DAP b) Second spray 70-80 DAP c) the Third spray 150-160 DAP	GA ₃ (0.001%L) 0.018gm/180 ml in 450-500 lit	Improve tillering
Sodium phenol sodium hydroxide and gibberellin	Two to three sprays	1.8% sodium phenol sodium hydroxide + gibberellin 40-50 mg/L	The combination promotes each other and improves the yield and quality by activating cell activity and metabolism in sugarcane
Gibberellin and sodium nitrate, and potassium dihydrogen phosphate	Two to three sprays	In the mixture of gibberellin and sodium nitrate, 2% potassium dihydrogen phosphate can be added.	It is helpful to promote the extension of sugarcane and increase the sugar content

Paclobutrazol	One to two sprays	Paclobutrazol concentration in 60—200 mgL ⁻¹	Increase sugarcane internodes, expand leaf area, growth speed, higher plant, stem diameter increased
GA ₃ and Glyphosate	Spray 2-3 months before harvesting	Combined concentration of 150-200 ppm of both GA ₃ and Glyphosate	Sucrose accumulation increased
Balsario	Spray 2-3 months before harvesting	Balsario chemical @4.5 kg per hectare in 1000 liters of water	It also enhances maturity 6-8 weeks earlier
Ethylene	120 days before harvesting cane	480 g a.i. ha ⁻¹ ethephon	Early maturity

CONCLUSION

Successive sugarcane plantation on the same piece of land will increase a load of biotic and abiotic factors on soil and causes production loss. Therefore, plant growth regulators and various chemicals can address the problems and enhance the yield by improving the quality of cane. Ethylene application in sugarcane improves germination and also leads to early maturity of cane; whereas, Gibberellin and Paclobutrazol improve the tillering and internode elongation of sugarcane. The combination of Gibberellin and Glyphosate increases sugarcane internodes, expands leaf area, growth speed, and higher plant and stem diameter. The spray of Balsario 2-3 months before harvesting will lead to the early maturity of cane. After harvest, a well-ripened sugarcane crop may lose its sucrose within a few days.

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