

## RESEARCH ARTICLE

## INFLUENCE OF HORMONES ON TILLER PRODUCTION, GROWTH, CANE YIELD AND JUICE QUALITY IN A SHY TILLERING SUGARCANE VARIETY

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### Abstract

The effect of growth regulators was studied in a field trial, with the objective of improving tiller production in a shy tillering variety Co 99004. The hormonal treatments consisted of - IAA (100 and 200 ppm), kinetin (50 and 100 ppm), ethrel (100 and 200 ppm) and water spray as control. The growth regulators were applied as foliar spray, at 30 and 45 days after planting. Ethrel @ 100 ppm produced significantly higher shoot population as well as number of millable canes (NMC) at harvest (74,814/ha as against 67,221/ha in control). Both the concentrations of kinetin and ethrel resulted in higher shoot population, while higher dose of IAA decreased shoot population. The number of millable canes (NMC) varied from 57,036/ha (IAA, 200 ppm) to 74,814/ha (kinetin 100 ppm). Both ethrel and kinetin at 100 ppm concentration produced higher NMC. Total biomass production at formative phase (150 days after planting) showed improvement in lower dose of (100ppm) IAA and ethrel (1.508 and 1.378 kg/m<sup>2</sup> respectively) and the trend lasted up to the completion of grand growth phase (240 days after planting). Cane yield was significantly higher in all the treatments except ethrel at 200ppm. The improvement in cane yield was 15% for IAA (100 ppm) and kinetin (100 ppm). Among the hormonal treatments, kinetin and ethrel improved the number of millable canes and also cane yield.

**Key words :** Hormones, IAA, kinetin, ethrel, shoot production, cane yield, juice quality

### Introduction

The number of millable canes (NMC) per unit area and the single cane weight are the two major factors that determine the cane yield. Under certain conditions, early and vigorous tillering is directly related to higher cane and sucrose yield. This is due to the fact that earlier formed stalks and primaries are invariably richer in sucrose content at maturity than the latter ones (McColl, 1976; Coleman, 1976; Shih and Gascho, 1980). To obtain maximum number of stalks (NMC), it is necessary to achieve high, early synchronized tillering and reduced tiller mortality. Concerted efforts have been made to elucidate the influence of spacing on tiller production in sugarcane (Vasantha et al. 2014). Varieties differ in their tillering response at

various levels of interplant competition as well as inputs. With increasing spacing, innate capacity for mortality decreases, due to lower levels of inter plant competition.

Ethephon, chloramquat, indole butyric acid, etc., have been used in inducing early tillering in sugarcane (Nickell, 1983). Studies conducted in India (Yadav and Prasad, 1987; Shetiya and Dendsay, 1991; Solomon et al. 1998); China (Wen et al. 1990; Cheng and Chen 1993; Liang et al. 1995b; Pan et al. 1997; Li et al. 1997; 2001; 2002; Xiang et al. 2002; Li and Solomon 2003) showed that foliar spray or sett treatment with growth regulators such as IAA, ethephon at low concentration promoted high tiller population, NMC and ultimately cane yield.

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Post-emergence application of ethephon increased tillering but caused reduction of shoots and leaf length. Since some sugarcane varieties are more sensitive to ethephon treatment than others, it is imperative that small-scale test be conducted at different rates before testing the enhanced tillering effects of ethephon in large areas. In this regard the present work was carried out to study the influence of growth hormones on tillering and yield related traits in a shy tillering variety Co 99004.

### Materials and Methods

A field trial was conducted in ICAR-SBI farm during (2010) in a randomized block design with seven treatments replicated thrice. Two budded sets of variety Co 99004, a shy tillering type, were planted in 6m row with six such rows in wide row (1.5m). The hormonal treatments were: T<sub>1</sub> (Water spray as control), T<sub>2</sub> (IAA 100 ppm), T<sub>3</sub> (IAA 200 ppm), T<sub>4</sub> (kinetin 50 ppm), T<sub>5</sub> (kinetin 100 ppm), T<sub>6</sub> (ethephrel 100 ppm), T<sub>7</sub> (ethephrel 200 ppm). The growth regulators were applied at 30 and 45 days after planting, as foliar spray. Observations on shoot

population, biomass during active growth stages were recorded. Juice quality analysis was carried out at 10<sup>th</sup> and 12<sup>th</sup> month, following standard protocol. Cane yield and related characters were recorded at harvest.

## Results and Discussion

### Shoot population

Shoot population during peak tillering stage (120 DAP) increased in most of the treatments, however higher dose of IAA (200 ppm) decreased shoot population compared to control. Shoot population in control was 78,240/ha and varied from 72,499/ha (IAA 200 ppm) to 91,573/ha in (ethephrel 100 ppm) among treatments (Table. 1). Higher dose of IAA (200 ppm) did not increase shoot population, on the contrary, it enhanced tiller mortality. Higher endogenous auxins were attributed to the shy tillering nature of varieties (Vasantha et al. 2004). Perhaps this explains the inhibitory role of exogenously applied IAA in promoting tiller population. Although, IAA improved cane yield the treatments did not improve shoot as well as stalk population.

**Table 1. Shoot population and NMC as influenced by hormone treatment**

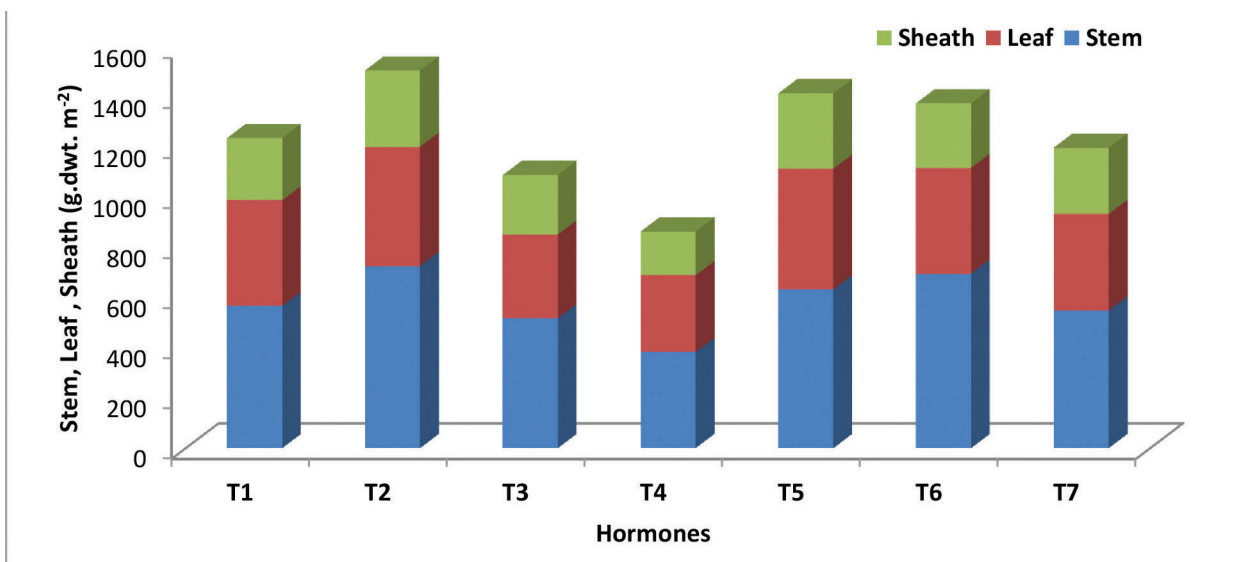
Hormonal treatment	Shootpopulation at 120 DAP (‘000/ha)	Number of Millable canes at harvest (‘000/ha)	Tiller Mortality%	Conversion of Tillers to stalk (%)
T <sub>1</sub> (Control)	78.240	67.221	14	85.9
T <sub>2</sub> (IAA 100ppm)	78.796	64.999	17	82.5
T <sub>3</sub> (IAA 200 ppm)	72.499	57.036	21	78.4
T <sub>4</sub> (kinetin 50 ppm)	78.888	62.407	20	79.1
T <sub>5</sub> (kinetin 100 ppm)	83.795	67.407	19	80.5
T <sub>6</sub> (ethephrel 100 ppm)	91.573	74.814	18	81.7
T <sub>7</sub> (ethephrel 200 ppm)	77.962	65.555	15	84.1
<b>CD at 5%</b>	<b>9.9</b>	<b>8.3</b>	--	--

**Table 2. Cane yield and juice quality at harvest as influenced by hormone treatment**

Hormonal treatment	Cane yield (t ha <sup>-1</sup> )	Single cane weight (kg)	Sucrose % juice	CCS%
T <sub>1</sub> (Control)	128.79	1.92	18.90	12.91
T <sub>2</sub> (IAA 100 ppm)	146.62	2.26	19.25	13.38
T <sub>3</sub> (IAA 200 ppm)	133.28	2.34	19.19	13.50
T <sub>4</sub> (kinetin 50 ppm)	135.21	2.17	19.23	13.25
T <sub>5</sub> (kinetin 100 ppm)	140.23	2.08	20.00	14.23
T <sub>6</sub> (ethrel 100 ppm)	137.75	1.84	18.29	12.35
T <sub>7</sub> (ethrel 200 ppm)	111.31	1.70	19.03	13.13
<b>CD at 5%</b>	<b>15.7</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

Shoot population improved significantly in the lower dose of ethrel and both the concentrations of kinetin at peak tillering phase (Table1). The improved tiller production due to ethrel and kinetin is in conformity with earlier reports (Yadav and Prasad, 1987; Shetiya and Dendsay, 1992) in sub-tropical as well as tropical varieties (Panneerselvam et al. 1999). Despite improvement in shoot population due to hormonal treatment,

the conversion percent of shoots to millable stalk was marginally reduced as compared to control (Table1). The growth and development of the young shoots depends on nutrients availability. Careful regulation of nutrient supply following hormonal treatment might improve the conversion of shoot to stalk. Late application of nitrogen followed in cane cultivation is an evidence for improved growth of cane stalk.

**Fig. 1a.** Effect of hormone on biomass partitioning in sugarcane at 150DAP

Conversion efficiency of shoots to stalk was higher in control, while all the treatments reduced conversion of tillers to stalk was observed (Table1). Single stalk weight suggested improved cane characteristics in hormone sprays as compared to control (Table 2) with higher single cane weight in both IAA and kinetin treatments.

### Biomass production

Total biomass production at formative phase showed improvement in lower dose (100 ppm) IAA and ethrel (1.508 and 1.378 kg/m<sup>2</sup> respectively), while higher concentration of kinetin(100 ppm) recorded 2<sup>nd</sup>higher biomass 1.417 kg/m<sup>2</sup>. In control (water spray) the biomass recorded was 1.239 kg/m<sup>2</sup> (Fig.1a)

Total dry matter production at 8<sup>th</sup> month of the crop varied from 2.69 kg/m<sup>2</sup> (200 ppm ethrel) to 3.67 kg/m<sup>2</sup> (100 ppm IAA). Dry matter produced in control and both the concentrations of kinetin were comparable, while both the concentrations of IAA(100 and 200 ppm) and lower concentration of ethrel (100 ppm) produced better higher

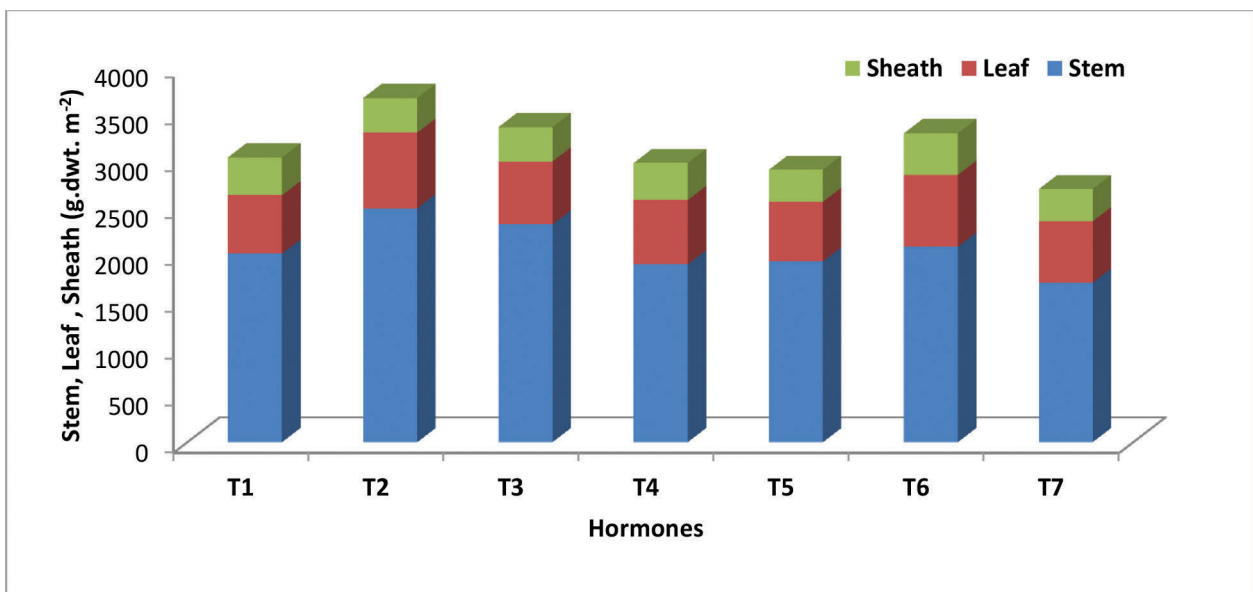
biomass (3.67, 3.35 and 3.33kg/m<sup>2</sup> respectively (Fig.1b) . Biomass allocation towards stem varied from 1.70kg/m<sup>2</sup> (ethrel 200 ppm) to 2.49kg/m<sup>2</sup> (IAA100ppm). Improvement in the above ground biomass was reported by Manjunatharao et al. (2005).

### Juice quality

At the completion of 360 days the sucrose % juice showed improvement. Despite improvement of up to 1.1 unit in kinetin@100 ppm, higher than control, the effect was statistically non-significant. Improved CCS% in response to ethephon application has been reported by several researchers (Wen et al. 1990, Cheng and Chen 1993, Liang et al. 1995, Li et al. 1997, 2001, 2002, Solomon et al. 1998, Panneerselvam et al. 1999, Xing et al. 2002, Manjunatharao et al. 2005).

### Cane yield at harvest

Hormonal application significantly improved cane yield in all the treatments except higher dose of ethrel (Table 2). Cane yield recorded at harvest for



**Fig. 1b.** Effect of hormone on biomass partitioning in sugarcane at 240 DAP

different treatments is as follows: IAA (100ppm) 146.62t/ha, IAA (200ppm) 133.28t/ha, kinetin (50ppm) 135.21t/ha, kinetin (100ppm) 140.23t/ha, Ethrel (100ppm) 137.75t/ha, Ethrel (200ppm) 111.31t/ha as against control which recorded 128.8 t/ha. Single cane weight increased numerically in all the treatments wherever NMC reduced. The improved cane yield from hormonal application is attributed to the increased single cane weight.

The tillering behavior is strongly influenced by the variety and the shy tillering variety produce sparse tillers in a limited time frame and tends to have uniform maturity of stalks at harvest. The hormonal application improved tiller population by 17% and NMC by 11%. However, the individual stalk weight decreased in the treatment which produced higher shoot population and NMC *viz.*, Ethrel 100 ppm. In other treatments the individual stalk weight increased with concomitant increase of cane weight (Table 2).

Among the hormonal application treatments, kinetin (100 ppm) and ethrel (100 ppm) improved the shoot population at 120 DAP, number of millable canes and cane yield at harvest.

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