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Effect of growth regulators and herbicides on growth and yield of sugarcane in central region of Iraq

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ABSTRACT

A field experiment was conducted at General Company for Industrial Crops, Dhuluiya in the central region of Iraq to study the effect of plant growth regulators and herbicides applied at the beginning of tillering stage on growth, yield attributes and yield of sugarcane variety 'Co 196'. The experiment was laid out in Split Plot Design with four replications. The main plots included herbicidal treatments 2,4-D and bentazone along with control (without herbicide) while sub plot treatments included plant growth regulators (PGR), GA_3, daminozide, mefluidide and control (without PGR).The results revealed negative association between cane height and cane yield due to over riding effect of growth regulator, mefluidide. The effect of herbicide 2, 4-D was, however, significant in increasing the number of millable canes which ultimately led to an increase in cane yield. GA_3 without herbicide when applied at tillering stage, had direct effect in increasing cane height and decreasing number of millable canes. However, growth regulator mefluidide with herbicide 2, 4-D produced highest number of thicker millable canes and cane yield.

Keywords: Agronomy, Sugarcane, Plant growth regulators, Herbicides.

Sugarcane with its cultivation being spread from 32ºN to 32ºS latitude occupies prominent place in world trade. It is an important agricultural and industrial crop and its commodity, sugar being the only article of food consumed without exception, in all countries of the world (Shuwell, 1999).

In Iraq, despite the lapse of more than four decades the sugar industry continues to produce small quantity (50000 t in 2003) not in commensuration with the existing capacity of 100000 t/year. This is primarily due to non–availability of required quantities of sugarcane as a result of decrease in the area under the crop and its low productivity (Almubarak 2004). One of the most important reasons for low productivity of sugarcane in Iraq is the spread of weeds especially during the tillering stage which of course must be free from crop–weed competition. Keeping this phase free of weeds has a positive impact in the early stimulation to form primary tillers and consequently increase in the number of millable canes (Almubarak 2011). The opportunity for initial tillers emerging to become effective millable canes later, may be achieved either by reducing weed growth through the chemical herbicides (Richard 1995) or by stimulating and increasing the number of tillers using industrial plant growth regulators (Hayamichi 1999).

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Studies have shown the possibility to obtain further increases in yield by the use of new technologies to enhance the physiological performance of plants through plant growth regulators (Artasit *et al*. 1994). The improvement in yield through chemical regulation of growth or weed control by the herbicides becomes essential. In order to control emergence and elongation of tillers as well as to speed up maturation through the use of growth regulators are necessary to increase the yield and sucrose. This new technology has not been used on the crop in Iraq earlier. Therefore, this is the first study of its kind in the country aimed at determining the effect of the biological interactions between plant growth regulators and herbicides in sugarcane crop and associated weeds.

MATERIALS AND METHODS

A field experiment was conducted on sugarcane in the General Company for Industrial Crops, Dhuluiya in the central region of Iraq. The objective of the experiment was to know the extent of response of sugarcane to growth regulators and herbicides. The experiment was laid out in split plot design with four replications. The herbicidal treatments *viz*., 2, 4-D and bentazone along with control treatment (without herbicide) were allocated to main plots, while growth regulators, GA_3, mefluidide and daminozide with additional treatment (without growth regulator) were assigned to sub plots. The soil of the experimental field was clay loam in texture with pH 7.6 and organic carbon 0.24%, available N P K of 139.2, 15.8 and 180.3 kg/ha, respectively. Each experimental plot measuring 42 m^2 contained four lines of 7 m length with row to row

spacing 1.5 m. The crop received 200 kg N/ha in two equal splits through Urea, first half before planting and second half three months after planting. The crop was fertilized with 120 kg P_2O_5/ha as triple super phosphate at planting time. The crop was irrigated at an interval ranging from 7 to 12 days according to crop need up to mid-October only. Growth regulators were sprayed on April 13, 2002 and after 10 days the herbicides were sprayed. Sugarcane was harvested on 27 January 2003. Observations for cane height (cm), stem diameter (mm) and number of canes including millable as well as non millable canes were recorded from two middle lines in each experimental plot. Cane yield (t/ha) was recorded by harvesting de-topped canes from central rows. The data recorded were statistically analyzed to compare between averages of treatments and test their significance at 5 % level (Steel and Torrie 1960).

RESULTS AND DISCUSSION

There were significant differences in cane height of sugarcane due to growth regulators (Table 1). Use of mefluidide led to a decrease in cane height (148.63 cm) as compared to control treatment (161.70 cm) and daminozide (159.34 cm). Use of herbicide bentazone caused the highest decrease in cane height (155.53 cm) compared to even control (163.08) cm which did not differ significantly from the treatment of 2,4-D herbicide (161.43 cm). As for interaction was concerned, use of GA_3 alone led to tallest plant of 176.8 cm, while use of mefluidide with 2, 4-D led to shortest plant of 143.2 cm. The reduction in cane height of sugarcane with mefluidide may be due to its role in preventing the synthesis of GA_3 in the plant resulting in the inhibition of cell division and elongation in apical meristem (Dick 1980). In turn, it retarded elongation of internodes and reduced cane height. The effect of daminozide in reducing cane height may be due to inhibition of GA_3 synthesis or increasing the concentration of growth inhibitor abscisic acid (Luckwill 1981). The plant height (170.37 cm) increased significantly with GA_3 compared to control treatment. The increase in cane height with the use of GA_3 could be due to an act of mutual synergy between the externally applied GA_3 and the inherent auxin present in the plant. As the GA_3 affects cell elongation by increasing the level of the internal normal auxin and the net effect is on the process of auxin building or on prevention of its oxidation. Galston and McCune (1961) opined that gibberellic acid affects the oxidized enzyme for IAA and known IAA oxidase and thus protects the oxidation of IAA. Gibberellic acid stimulation relates to the process of converting tryptophan to IAA, and thereby the role of auxin in cell elongation. Hassan *et al*. 1976 explained that the IAA increases the absorption of nutrient elements inside the plant tissues, leading to increased plant growth. Mohammed (1992) also pointed out that GA_3 stimulates translocation of nutrients from the leaves towards stems, a process known as remobilization than to increase the plant height.

These findings are consistent with those of Hayamichi (1999) reporting a decrease in average plant height of sugarcane crop with use of mefluidide, and also with the findings of Bahadar (1987) who found a decrease in increment rate of plant height of sugarcane crop when mefluidide was used on plants aged 3 months but not on 9 months old ones. Artasit *et al*. (1994) observed the same with the use of daminozide.

Number of canes was significantly affected by use of plant growth regulators (Table 2). Addition of mefluidide led to a significant increase in number of millable canes to 60.77 per plot compared to the control treatment (56.93/plot). The effect of mefluidide was also reflected in reducing the number of non-millable canes to 2.8. As for herbicides, bentazone caused maximum increase in average number of non-millable canes to 5, while 2,4-D produced the highest number of millable canes of 61.30 per plot. The interaction of growth regulator, mefluidide with herbicide 2, 4-D produced the highest number of millable canes of 73.30 per plot, while growth regulator GA_3 alone produced the highest number of non-millable canes (9.6) in comparison to the control treatment.

The higher number of millable canes and less number of non millable canes obtained with mefluidide may be due to the fact that the early treatment with growth retardant reduces the sink capacity of the primary shoots because of inhibition of growth and availability of photosynthates contributes more to stimulate the growth of buds and its development at the beginning of its appearance (Ma and Smith 1992). Also, early treatment with growth retardants leads to stimulation of tillers and gives the new tillers enough time to grow and develop thoroughly.

Addition of GA_3 caused a significant decrease in number of millable canes to 46.63 per plot as compared to the control treatment. There was a significant increase in number of non

Table 1 Effect of plant growth regulators (PGR) herbicides interactions on plant height (cm) of sugarcane

Mean	Control	Mefluidide	GA_3	Daminozide	Treatment
163.08	162.7	152.4	176.8	160.4	Control
155.53	155.4	150.3	161.8	154.6	Bentazone
161.43	167.0	143.2	172.5	163.0	2, 4-D
	161.70	148.63	170.37	159.34	Mean
L.S.D. at 5%	**PGR**	**Herbicide**	**PGR x Herbicide**		
	8.04	**3.28**	**12.41**		

Table 2 Effect of plant growth regulators (PGR) and herbicides interactions on number of millable and non-millable canes (per plot) of sugarcane

Treatment	Daminozide	GA_3	Mefluidide	Control	Mean
Control	57.3	53.4	61.7	60.8	58.3
Bentazone	53.7	52.2	55.0	54.1	53.75
2, 4-D	62.0	54.6	75.3	66.6	64.63
Mean	**57.67**	**53.4**	**64.0**	**60.50**	
L.S.D. at 5%		**PGR**	**Herbicides**	**PGR x Herbicides**	
		4.59	**6.11**	**16.28**	

Table 3 Effect of plant growth regulators and herbicides on number of millable canes per plot

Treatment	Daminozide	GA_3	Mefluidide	Control	Mean
Control	55.5	43.7	58.6	58.5	54.08
Bentazone	50.6	44.8	50.4	49.0	48.70
2, 4-D	57.2	51.4	73.3	63.3	61.30
Mean	**54.43**	**46.63**	**60.77**	**56.93**	
L.S.D. at 5%		**PGR**	**Herbicide**	**PGR x Herbicide**	
		2.96	**6.08**	**10.41**	

Table 4 Effect of plant growth regulators and herbicides on number of non-millable canes per plot

Treatment	Daminozide	GA3	Mefluidide	Control	Mean
Control	2.0	9.6	2.6	2.0	4.05
Bentazone	3.1	7.4	4.3	5.2	5.00
2, 4-D	5.4	3.3	1.7	3.2	3.40
Mean	**3.50**	**6.77**	**2.87**	**3.47**	
L.S.D. at 5%	**PGR**	**Herbicide**	**PGR x herbicide interaction**		
	0.53	**0.89**	**4.37**		

millable canes to 6.77 compared to 3.47 in control. However, daminozide did not alter significantly both the number of millable or non-millable canes.

The findings that there was an increase in number of non-millable canes and decrease in number of millable canes when GA_3 is added at the beginning of tillering stage are consistent with the findings of Taha *et al*. 1992.

For stalk diameter, addition of plant growth regulator, mefluidide caused a significant increase to 32.47 mm compared to the control treatment (29.60 mm). Herbicides did not show significant effect on stalk diameter. As for interaction, use of mefluidide with 2, 4-D led to thickest stalk diameter of 34.8 mm which did not differ significantly from mefluidide treatment alone recording stalk diameter 32.2 mm. The increase in rate of stem diameter by adding mefluidide, especially the lower internodes at the expense of plant height, may be due to its mode of action. These findings are consistent with the findings of Bahadar (1987) who observed an increase in stalk diameter of sugarcane with the use of mefluidide on plants having attained 3 months age.

For cane yield, application of plant growth regulators significantly affected the sugarcane yield. Mefluidide

Table 5 Effect of plant growth regulators and herbicides on stalk diameter (mm)

Treatment	Daminozide	GA_3	Mefluidide	Control	Mean
Control	29.3	26.9	32.2	30.0	29.60
Bentazone	29.7	28.6	30.4	29.7	29.60
2,4-D	29.5	27.0	34.8	29.1	30.10
Mean	**29.50**	**27.50**	**32.47**	**29.60**	
L.S.D. 5%	**PGR**	**Herbicides**	**PGR x Herbicides**		
	2.03	**N.S.**	**4.17**		

Table 6 Effect of Plant Growth Regulators and Herbicides on cane yield (t/ha)

Treatment	Daminozide	GA3	Mefluidide	Control	Mean
Control	54.0	38.8	58.3	52.6	50.93
Bentazone	50.7	39.4	51.5	47.2	47.20
2,4-D	57.8	47.9	64.6	56.2	56.63
Mean	**54.17**	**42.03**	**58.13**	**52.00**	

L.S.D. 5%	**PGR**	**Herbicides**	**PGR x Herbicides**
	2.70	**3.25**	**7.08**

significantly increased the cane yield to 58.1 t/ha compared to 52.0 t/ha in control treatment. Herbicide 2, 4-D also recorded a significant increase in yield of sugarcane (56.6 t/ha).

The interaction, mefluidide with 2, 4-D produced the highest cane yield of 64.6 t/ha, while GA_3 with bentazone caused significant reduction in yield (39.4 t/ha). On the other hand, bentazone alone produced cane yield of 47.2 t/ha. The increase in yield of sugarcane as a result of the use of mefluidide in early crop stage is on account of its role to increase stalk diameter and total number of all canes (Table 2) as well as reduction in the number of non-millable canes (Table 4).

Therefore, it is inferred that stimulating growth of tillers since the beginning led to storage of large amount of photosynthates which was reflected positively to produce more number of millable canes. The reduction in cane yield by the addition of GA_3 at the early crop stage is due to the metabolic role of this compound in increasing the number of non-millable canes depleting large amounts of nutrients.

REFERENCES

Almubarak N F. 2004. Response of sugarcane (*Saccharum officinarum* L.) and companion weeds to plant growth regulators and herbicides. *Dissertation*. College of Agriculture, Baghdad University, Iraq.

Almubarak N F. 2011. Effect of methods of weed control and varieties in quality characters, sugar yield and companion weeds of Sugarcane (*Saccharum officinarum* L.) In: Twelfth Scientific Congress. Technical Education Commission, Baghdad, Iraq : 309-20.

Artasit B, Prapan P, Preecha P, Dhanit S, Charan A, Thongchai T and Ruthapon C. 1994. Foliar application of ripener for increasing sugar content of 8 sugarcane varieties in the early milling period. Suphan Buri Field Crops Research Center (Thailand). 31. (C.F. AGRIS ONLINE).

Bahadar Q. 1987. Effect of various ripeners (polaris, polado, cycocel, etherel, ethephon, embark, round up, asulox, gramoxone, dalapon, GA, 2, 4-D, Mefluidide and Recuza) on sugarcane. Peshawar (Pakistan). 33. (C.F. AGRIS ONLINE).

Dick J W. 1980. Modes of action of growth retardants. In: *Recent development in the use of plant growth retardant*. Eds. D.R. Clifford and J.R. Lenton. British Plant Growth Regulator Group Monograph (4): 1-14.

Galston A W and Mc Cune D C. 1961. An analysis of gibberellin-auxin interaction and its possible metabolic basis. In: *Plant Growth Regulation*. (Ed. Klein R M). The Iowa State University Press, Ames. Iowa. pp. 611.

Hassan H M, El-shafey Y H and Kheir N F. 1976. Growth and grain yield of corn plant as affected by 2, 4-D and micro nutrients. *Annals of Agricultural Sciences* **(6)**:149-56.

Hayamichi Y. 1999. Effects of plant growth retardant on growth and sugar accumulation of sugarcane (*Saccharum officinarum* L.) Journal of Agricultural Science Tokyo–Nogoyo-Daigaku **43(4)**: 197-201. (C.F. AGRIS ONLINE).

Luckwill L C. 1981. Growth regulators in crop production. The Institute of biology's. Studies in biology. No.129.

Ma B L and Smith D L. 1992. Modification of tiller productivity in spring barley by application of chlormequat or ethephon. *Crop Science* **32**: 735-40.

Mohammed B A. 1992. Effect of concentration and date of add some plant growth regulators on yield and its components of maize. *Thesis.* Faculty of Science – University of Baghdad.

Richard E P. 1995. Sugarcane (*Saccharum* spp.) response to simulated fluazifop – butyl drift. *Weed Science* **43**(4): 660-5.

Shuwell S. 1999. Sugar industry is clean and unpolluted environment. Executives Society of Egyptian sugar. 30th Annual Conference.

Steel G D R and Torrie J H. 1960. *Principles and procedures of statistics*. McGraw-Hill. New York.

Taha E M, El-Sherbeny A A and El-Ashmoony M S. 1992. Influence of nitrogen levels and gibberellic acid on sugar cane. *Minia-Journal of Agricultural Research and Development* **8**(2): 515-30.