

Effect of Hormones on the Sugar Level of Maize (*Zea mays* L.) Plants

by

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Introduction: Mortimore and Ward (1964) reported that physiological vigour depends upon a steady respiration rate supported by a continuous supply of carbohydrate reserve, always assuming an adequate and balanced level of nutrients. When the vigour of a plant drops below a certain level because of stress conditions under which it is grown, it becomes susceptible to invasion by certain saprophytes and weak parasites. Craig and Hooker (1961) working with *Diplodia* stalk rot found that a decrease in the sugar level of the stalk causes senescence of pith tissue and susceptibility to pathogens.

Though a considerable amount of work has been reported in literature as regards the effect of hormones on the elongation of plant (Brain *et al.* 1954, Gray, 1957; Marth *et al.* 1956; Yabuta *et al.*, 1941) little work has been done concerning its effect on the chemical composition of plants. Stuart (1938) studied the effect of 0.01% solution of IAA on kidney bean cuttings and found an accumulation of carbohydrates in the cut ends which were in the solution for four hours. Mitchell and Stuart (1938-39) have further shown that when IAA was applied to bean cuttings there was an accumulation of sugars. West (1949) also found a temporary increase in the total available carbohydrates in the stem of Buck-wheat when treated with 2, 4-Dichlorophenoxy acetic acid. Greulach and Singh (1949) concluded that the leaves of NAA treated plants had a higher rate of photosynthesis per unit area than control plants. Mc-Illarth (1950) while studying the effect of maleic hydrazide in the form of di-ethanolamine salt on the growth of cotton plant found that the leaf blades of treated plants contained more carbohydrates than the leaf blades of the control plants. Dastur and Bhatt (1956) found a greater accumulation of cane sugar in the leaves of the hormone treated cotton plant.

The present investigation was undertaken to study the sugar levels of the maize plant as affected by application of some hormones.

Materials and Methods: Maize plants (*Zea mays* L. variety *Ganga-3*) were grown under greenhouse conditions in pots containing 20 kg. soil. Each pot contained a single plant. The soil was taken from the Farm at

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Government Agricultural College, Kanpur. Pots were fertilized at 120 kg. N, 60 kg. P_2O_5 and 60 kg. K_2O potash per hectare supplied as Calcium ammonium nitrate, Super phosphate and Potassium sulphate respectively. The seeds were sown on March 22, 1967 and the harvesting was done on 14th June, 1967. Prior to sowing the seeds were soaked for twenty four hours in aqueous solutions of hormones having various concentrations. The hormones and their concentrations used in the experiment were: (1) Gibberellic Acid (2) Indole Butyric Acid (3) Indole Acetic Acid and (4) Naphthalene Acetic Acid each at 5, 10, 15 and 20 ppm. Control seeds were soaked in distilled water.

The treatments were replicated nine times and pots randomized within each replicate. The pots were rotated periodically to reduce the effects of localized environmental condition in the greenhouse. Samples were taken 3, 9 and 12 weeks after sowing, collected at 11 a. m. on each sampling date. Each sample prepared for chemical analysis was composite of tissues from three corn plants, each plant taken from single replicate. Thus at the time of harvesting only three replications were left. Composite samples of three different tissues of leaf, internode rind and pith from the corn plant were analysed. Samples were analysed for reducing sugars and sucrose by methods described by Ward and Johnston (1962).

Results and Discussion: The results of the experiment are being presented in the Table.

Analysis of maize plant tissues from hormone treated seeds revealed that these hormones have helped plants to maintain higher concentration of sugars in their tissues than the control ones. Maximum increase of the sugar content is observed in the maize plant tissues from Gibberellic acid-treated seeds. Keeping in view their effectiveness in bringing about an increase in sugar content, the various hormones can be placed in the following order: $GA > NAA > IBA > IAA$.

As is evident from the Table that among all the concentrations of Indole acetic acid, 20 ppm. has given the highest sugar content in maize plant tissues, while in the case of other hormones *viz.*, GA, NAA, IBA best results are obtained by soaking the seeds in 15 ppm. solutions. Use of the higher concentrations of these hormones have not resulted in further higher concentrations of sugars, instead a decrease is noted in the concentration of sugars by using a higher concentration *i. e.* 20 ppm. Possibility that still higher concentration of these hormones may become toxic also cannot be ruled out. However, no consistent relationship was found between reducing sugar or sucrose alone with the hormone treatment of seeds.

TABLE. Total sugars (reducing sugars plus sucrose) in maize plant tissues as percentage of dry weight

Hormones	Tissue			Internode rind			Internode pith				
	Sampling date	12-4-'67	24-5-'67	14-6-'67	12-4-'67	24-5-'67	14-6-'67	12-4-'67	24-5-'67	14-6-'67	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
GA	...	5	7.7	8.8	8.2	32.4	19.4	12.6	58.1	32.2	21.1
		10	8.2	9.3	8.7	35.3	22.2	13.8	58.9	34.9	23.3
		15	8.5	9.7	9.1	36.9	23.1	14.5	59.6	35.8	24.0
		20	6.5	7.8	6.7	29.5	17.6	10.9	55.6	29.2	18.9
IBA	...	5	6.4	7.3	6.1	28.5	18.7	11.8	56.5	28.3	19.4
		10	6.8	7.9	6.3	30.2	19.6	12.1	56.9	30.3	20.2
		15	7.2	8.4	6.8	31.7	20.8	12.6	57.7	31.7	21.2
		20	6.9	8.0	6.8	30.5	19.5	12.3	58.9	30.2	20.0
IAA	...	5	6.4	7.3	5.8	27.0	17.9	11.4	55.8	25.9	18.7
		10	6.6	7.7	6.0	27.9	18.3	11.6	56.4	26.6	19.2
		15	6.9	7.9	6.5	29.1	19.6	11.9	57.0	28.7	20.1
		20	7.0	8.2	6.4	29.6	19.9	12.2	57.4	28.8	20.3
NAA	...	5	7.1	8.0	7.5	31.8	19.2	12.1	57.6	31.2	20.3
		10	7.5	8.5	7.9	34.1	21.6	13.0	58.3	33.9	22.3
		15	7.9	9.0	8.6	35.1	22.5	13.8	58.9	35.2	23.4
		20	6.7	7.9	7.1	30.3	19.0	12.0	56.8	29.8	20.1
Control (Soaked in distilled water)			6.2	7.0	5.3	26.2	17.3	11.1	55.2	25.7	17.9

Since the sugar content of maize tissues is influenced by hormone treatment of the seeds and that the sugar level in the plant tissues is considered as a measure of plant vigour and resistance to plant diseases, it is evident that the treatment of seeds with hormones can be used as an effective means for making the plants resistant to invasion by saprophytes and parasites.

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