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INFLUENCE OF GIBBERELLIC ACID ON GROWTH AND METABOLISM OF CUCUMBER SEEDLINGS

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ABSTRACT

The presented results demonstrate the inhibitory effect of gibberellic acid towards root length, nitrogenous contents (total - N_2, total - soluble nitrogen & proteins) of cucumber seedlings. Alternatively, gibberellic acid showed a stimulatory effect on the germination percentage, hypocotyl length, carbohydrate contents (total - soluble, reducing and non - reducing sugars), and amylase activity whereas, the activity of proteases and lipases showed non-significant increase in response to GA_3 treatments.

INTRODUCTION

Physiological effects of gibberellic acid and other gibberellins have been confined largely to descriptive accounts of stimularory and inhibitory actions, while still few studies have attempts to integrate the action of gibberellic acid with the normal physiological processes of the plants. In this regard, hormones have been shown to promote the growth patterns of several plants (Johnson *et al.*, 1959; Said *et al.*, 1966; Kathju *et al.*, 1972; Mayer & Poljakoff - Mayber, 1975; Ekram & Moussa, 1981; Brar & Singh, 1982; Paul & Singh, 1985; Sharma and Govil, 1985; Dale, 1986 and Haba *et al.*, 1987).

Metabolism of some plants with respect to gibberellic acid application were investigated by several authors; Strebko, 1971 working on barley and wheat seedlings, Nabih and Alis, 1974 on horse bean; Allfrey and Northcote, 1977 on *Arachis hypogea*; El-Fergany *et al.*, 1977 on clover; El-Sherbeny, 1982 on Vicia faba; Doijode and Rao, 1983 on pea seedlings; Paul and Singh, 1985 on lentil and Fahmy *et al.*, 1987 on Kenaf and roselle seedlings.

The present work was planned to investigate the influence of the different

concentrations of gibberellic acid on growth of cucumber seedlings as well as the quantitative changes of carbhydrates, nitrogenous constituents, protein contents and the proteolytic, lipolytic and amylolytic activities.

MATERIAL AND METHODS

MATERIALS :

Cucumber seeds (*Cucumber sativum* var., *Biet alpha* were obtained from the Ministry of Agriculture, Egypt. Uniform seeds were selected, then soaked in different concentrations of gibberellic acid containing solution (0.0, 100, 150 and 200 ppm.) for 6 hours. The soaked seeds were sprinkled on moistened filter paper in petri-dishes (9 cm. in diameter) and incubated at 30 °C. for 7 days. The germinated seeds of cucumber were irrigated daily with 5 mls distilled water. The length of roots and hypocotyl as welll as the fresh and dry weights of the seedlings for each treatment were considered. Samples of 7 - days old seedlings of cucumber were taken and dried at 80°C till constant weight, then ground to a fine powder for the biochemical analysis (carbohydrates and nitrogenous constituents). Another weight of cucumber seedlings were chilled at 20°C for 15 minutes in the presence of suitable amount of glass powder, thereafter were vigorously ground in a morter using distilled water to bring about a thick paste of the plant tissues. The plant homogenate was filtered, the filtrate was transferred to a measuring cylinder and completed to 100 mls by distilled water and then centrifuged at 8000 rpm. for 15 minutes. The supernatant was used as cell free extract for determination of amylases, lipases and proteases activities.

METHODS :

Determination of total-soluble carbohydrates :

Contents of the total-soluble carbohydrates were determined using the method of Umbriet *et al.*, (1959) & Said *et al.*, (1964). Sucrose was used as a standard carbohydrate.

Determination of reducing & non-reducing sugars :

Reducing and non-reducing sugars were determined according to Somogyi (1937) and Younis (1963).

Estimation of nitrogenous compounds :

Total - N_2 contents and the total-soluble nitrogen were determined as mentioned by Humphries (1956) and Pirie (1955). Protein nitrogen contents were determined as described by Cantarow and Schepartz (1967).

Proteases enzymes :

Contents of proteases enzymes were measured using spectrophotometer according to that method of Kunitz (1947).

Amylases enzymes :

Amylolytic activities wer estimated spectrophotometrically according to that method adopted by Smith and Roe (1949).

Lipase enzymes :

Lipolytic activities were determined using tributyrin clearing zone (T.C.Z.) assay as described by Lawrence *et al.*, (1967) and modified by Elwan *et al.*, (1984).

Statistical Analyses of Results :

The obtained data were statistically analyzed using the " T " test. Significance (S) and highly significance (HS) were obtained by concidering the value of " T " at 0.05 and 0.01 levels respectively. Non-significant (NS) means that the value of " T " was less than that listed at 0.05.

RESULTS AND DISCUSSION

Results shown in Table (1) revealed that gibberellic acid markedly increased the germination percentage. It was observed taht the high percentage of

germination was obtained at the high concentration of GA_3. Contrary to that gibberellic acid inhibited the root length. The inhibition of root growth was permenant and increased with increasing GA_3 concentration. On the other hand, gibberellic acid showed a marked stimulatory effect on the hypocotyl length. The increase in the hypocotyl lengthes were found to be highly significant. Our data are in agreement with those of Mayer and Poljakoff-Mayber (1975); Paul and Singh (1985); Dale (1986) and Haba *et al.*, (1987), who reported increases in germination percentage as well as in hypocotyl growth in relation to the effect of gibberellic acid treatments. However, Ekram and Moussa (1981) and Brar & Singth (1982) noticed a reduction in cotton root length, while the hypocotyl length was increased in response to gibberellic acid application.

Table (1): Effect of gibberellic acid (GA_3) on th germination %, lengths of root and hypocotyl. Each value is a mean of 15 determinations. ± = Standard error of mean.

GA_3 Conc. ppm.	Germination decr-	%	Root length % length	% incr- ease	Hypocotyl (in cm.) (in cm.)	% incr- ease
0-0 Cont.	92.3 ± 0.03	___	9.7 ± 0.22	___	2.8 ± 0.08	___
100	94.5 ± 0.20 + H.S.	2.3	3.6 ± o.13 - H.S.	63.00	3.5 ± 0.02 + H.S.	25.00
150	96.2 ± 0.01 + H.S.	2.2	2.9 ± 0.08 - H.S.	70.00	4.3 ± 0.04 + H.S.	53.85
200	97.3 ± 0.05 + H.S.	5.4	0.4 ± 0.01 - H.S.	95.50	5.4 ± 0.13 + H.S.	92.85

Concerning the effect of different concentrations of GA_3 on the chemical composition (Table 2), the total - soluble carbohydrates were increased with gibberellic acid treatment. These increases were highly significant by 16.7%, 50.0% and 91.7% at gibberellic acid concentration of 100, 150, and 200 ppm. respectively. Reducing as well as non-reducing sugars were found to be increased with gibberellic acid treatments (Table 2). It was found that those increases are

highly significant particularly for reducing sugars. At 100 and 150 ppm GA_3, the contents of non-reducing sugars showed non-significant increased at 200 ppm., those increase was highly significant. These findings are cosistent with those obtained by Fahmy *et al.*, (1987) who showed that GA_3 (50, 100 and 200 ppm.) increased the monosaccharides and sucrose of kenaf and roselle. Doijode and Raw (1983) observed an increase of total - sugars by 12.64 % over the control in GA_3 treated pea seedlings. Moreover, Allfrey and Northcote (1977) found that Arachis hypogaea of 8 - days old seedlings treated with GA_3 accumulated monosaccharides and sucrose.

With regards to the effect of gibberellic acid on the nitrogenous contents of cucumber seedlings, the total nitrogen, total soluble nitrogen as well as proteins

Table (2): Errect of gibberellic acid (GA_3) on the contents of total- soluble carbohydiates, reducing and nonreducing sugars (mg / g.oven dry weight). Each value is a mean of 3 readings. ±=Standard error of mean.

GA_3 Conc. (ppm)	Total-soluble carbohydrate (mg. / g.)	% incr-ease	Reducing sugars (mg. / g.)	% decr-ease	Non-reducing sugars (mg / g.)	% incr-ease
0-0 (Cont)	3.36 ± 0.0	___	0.83 ± 0.01	___	1.90 ± 0.01	___
100	3.92 ± 0.28 N.S.	16.7	1.51 ± 0.00 + H.S.	81.90	1.98 ± 0.05 N.S.	4.20
150	5.04 ± 0.00 + H.S.	50.0	2.72 ± 0.05 + H.S.	227.70	2.05 ± 0.06 N.S.	7.90
200	6.44 ± 0.28 + H.S.	91.7	2.90 ± 0.00 + H.S.	249.30	3.10 ± 0.01 + H.S.	63.20

were markedly decreased with increasing gibberellic acid concentratrions (Table 3). The decreases in the contents of both total-nitrogen and proteins as a results of gibberellic acid treatments were observed by several investigators (Nabih and Alis, 1974 working on *Vicia faba*; El-Fergany *et al.*, 1977 on clover and Paul and Singh, 1985 on lentil).

Table (3): Effect of gibberellic acid (GA_3) on the content of nitrogenous constituents of cucumber seedlings. Each value is a mean of 3 determinations. ± = Standard error of mean.

GA_3 Conc. (ppm)	Tqtal - N_2 (mg./ g.)	% decr-ease	Total-soluboe nitrogen (mg. / g.)	% dec-rease	Proteins (mg. / g.)	% dec-rease
0-0 (Cont)	3.60 ± 0.05	___	2.10± 0.01	___	22.50 ± 0.31	___
100	22.75 ± 0.03 - H.S.	23.6	1.50 ± 0.02 - H.S.	28.6	17.19 ± 0.19 - H.S.	23.6
150	2.50 ± 0.05 - H.S.	30.6	1.53 ± 0.01 - H.S.	27.1	15.63 ± 0.38 - H.S.	30.5
200	2.33 ± 0.01 - H.S.	35.3	0.91± 0.05 - H.S.	56.7	14.56 ± 0.06 - H.S.	35.3

Regarding the hormonal control of enzyme activities in higher plants, Varner and Ho (1977) mentioned that, there are now hundreds of known instances in which a change in tissue concentration of a hormones and / or the exogenous addition of hormone changes the level of activity of one or more enzymes. In nocase it is known precisely how the tissue controls the level of enzyme activiey in response to the changed hormone concentration. Data presented in (Table 4) show that gibberellic acid treatments led to non-significant increases in proteases enzymes activity. These are in agreement with Strebko (1971) work on barley as well as wheat seedlings of 8 - days old seedlings of *Arachis hypogaea* treated with gibberellic acid.

The results in Table (4) also reveals that lipolytic activities were increased in a non-significant order.

Table (4): Effect of gebberillic acid (GA_3) on enzyme activities (Ug /g. oven dry weight) of cucumber seedlings. Each vlue is a mean of 3 rendings.± = Standard error of mean.

GA_3 Conc. (ppm)	Proteases enzyme (Ug. / g.)	% incr-ease	Amylases enzyme (Ug. / g.)	% encr-ease	Lipases enzyme (Ug. / g.)	% incr-ease
0-0 Cont.	0.119 ± 0.02	___	1.06 ± 0.11	___	0.20 ± 0.02	___
100	0.121 ± 0.01 N.S.	1.7	3.04 ± 0.09 + H.S.	186.8	0.23 ± 0.05 N.S.	15.0
150	0.124 ± 0.01 N.S.	4.2	4.00 ± 0.05 + H.S.	277.4	0.23 ± 0.01 N.S.	15.0
200	0.130 ± 0.03 N.S.	9.2	5.17 ± 0.10 +H.S.	289.7	0.30 ± 0.03 N.S.	50.0

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الملخص العربى

تأثير حمض الجبريلليك على النمو وتغذية بذور وبادرات نبات الخيار

يهدف هذا البحث إلى دراسة تأثير الجبريللين على بذور وبادرات نبات الخيار وقد اتضح من البحث أن للجبريللين تأثير مثبط على نمو الجذور وكذلك المركبات النيتروجينية وبالدراسة ثبت أن الجبريللين يزيد نسبة الإنبات وكذلك نسبة السكريات مما يمكن البادرات من امتصاص الماء نتيجة لزيادة الضغط الأسموزى وبالإضافة إلى ذلك فإن نشاط انزيم الأميلاز يتزايد على العكس من نشاط انزيمى البروتياز والليباز الذى ينقص نشاطهما .