Effect of Plant Growth Regulators on Chlorophyll Content, Nitrate Reductase Activity and Sugar Content in Cucumber (*Cucumis sativus* L.)

KEYWORDS: Plant growth regulators, chlorophyll content, nitrate reductase activity

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ABSTRACT *A field experiment was conducted to study the effect of plant growth regulators on various biochemical parameters viz.,chlorophyll content, nitrate reductase activity and sugar content in cucumber cv. Belgaum Local. Foliar application of GA3 @ 50 ppm was found to be superior in all the characters compared to other treatments. However, at 40 DAS, both chlorophyll content and nitrate reductase activity in leaves did not differ significantly, though there was an increase in its content due to application of growth regulators. The sugar content in fruits also increased significantly with GA3 @ 50 ppm and CCC @ 500 ppm compared to all the treatments.*

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one of the most important and popular vegetable crops belonging to the family Cucurbitaceae. The fruits are highly nutritive and have very high water content and very low calories. The fruit is used as a vegetable or salad. It is rich in minerals, thiamine, niacin and vitamin C. (0.38 g, 0.3 mg, 0.2 mg and 78 mg, respectively per 100 g of edible fruit). Fruits consist about 80 percent of edible portion which contains 95% water, 0.7% protein, 0.1% fat, 3.4% carbohydrates, 0.4% fiber and 0.4% ash (Aykroyd, 1963).

It is an ideal summer crop chiefly grown for its edible tender fruits preferred as salad ingredient, pickles, dessert fruit and as a cooked vegetable. Its high water content makes it diuretic. Cucumber has a cleansing action within the body by removing accumulated pockets of old waste material and chemical toxins. It also helps in the treatment of arthritis, since it helps eliminate uric acid. Its low calorie makes it perfect food for diet. Cucumber is a women's friend when they are on a diet but also for its cosmetic properties.

Plant growth regulators (PGRs) are organic compounds, other than nutrients that modify plant physiological processes. PGRs, called biostimulants or bioinhibitors act inside plant cells to stimulate or inhibit specific enzymes or enzyme systems and thus regulate plant metabolism. They normally are active in low concentrations in plants. About sixty plant regulators are commercially being used and several of them have reached considerable importance in crop production. Growth regulators include both growth promoters and retardants which have shown to modify the canopy structure and other yield attributes.

Though the plant growth regulators have great potentialities to influence plant growth and morphogenesis, its application and actual assessments etc. have to be judiciously planned in terms of optimal concentrations, stage of application, species specificity, seasons, etc. which constitute the major impediments in PGRs applicability. In view of their wide spectrum effectiveness on every aspect of plant growth, even a modest increase of 10-15 percent could bring about an increment in the gross annual productivity by 10-15 million tons. With this background, the present investigation was carried out with the objective to find out the effect of plant growth regulators on yield potential and quality in cucumber.

MATERIALS AND METHODS

A filed experiment was conducted at Main Agricultural Research Station, University Agricultural Sciences, Dharwad during rabi/summer 2009 with an objective to find out the influence of plant growth regulators on chlorophyll content, nitrate reductase activity and sugar content in cucumber in cucumber (*Cucumis sativus*) cv. Belgaum Local. The experiment consists of nine treatments having two growth promoters viz., gibberrellic acid (50 and 100 ppm), naphthalene acetic acid (50 and 100 ppm), a retardant CCC (250 and 500 ppm), salicylic acid (500 and 1000 ppm) and a control. The experiment was laid out in randomized block design with three replications on black clay loam soil. The spacing adopted was 2.0 m (between rows) and 0.75 m (within rows) with a plot size of 6.0 m x 4.5 m.

The various biochemical parameters were studied at different stages. The chlorophyll content and nitrate reductase activity were estimated at 40, 55 and 70 DAS using DMSO method devised by Shoaf and Lium (1976) and Saradhambal et al. (1978) respectively. The reducing sugar content in fruits was estimated by Nelson method (1941). Total sugar content was estimated by Anthrone method and the non reducing sugars were estimated by subtracting the reducing sugar from the total sugar.

The data were subjected to the analysis of variance by following the method of Panse and Sukhatme (1967). The level of significance used in 'F' and 't' test was P = 0.5. Critical difference (C.D) values were calculated at 5 percent level wherever 'F' test was significant.

RESULTS AND DISCUSSION

The data on chlorophyll content presented in Table 1 indicated that there was increase in chlorophyll upto 55 DAS and thereafter it decreased. There was no significant difference in chlorophyll a, b and total chlorophyll at 40 DAS. At 55 DAS, significantly higher chlorophyll 'a' (1.347) was recorded in GA3 @ 50 ppm followed by GA3 @ 100 ppm. Chlorophyll 'b' was also increased with GA3 @ 50 ppm followed foliar application of NAA @ 100 ppm. The total chlorophyll showed a similar trend with GA3 @ 50 ppm showing maximum total chlorophyll (1.664) followed by NAA @ 100 ppm. At 70 DAS, GA3 @ 50 ppm continued to show maximum chlorophyll 'a', 'b, and total chlorophyll among all the treatments. Control recorded minimum chlo-

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rophyll 'a', 'b, and total chlorophyll at all the stages. The increase in the photosynthetic rate due to GA3 was attributed to enhanced ultra-structural morphogenesis of plastids and increase in Rubisco activity (Arteca and Donga, 1981).

Plant growth regulators exhibited significant differences in nitrate reductase activity (NRA) in leaves (Table 2). However at 40 DAS, there was no significant difference among the treatments. The present study revealed that NRA was maximum at 55 DAS and increased significantly with the foliar application GA3 @ 50 and 100 ppm followed by CCC @ 500 ppm as compared to control. At 70 DAS, GA3 @ 50 ppm continued to show maximum NRA (79.41) followed by CCC @ 500 ppm and CCC @ 250 ppm. Lawlor and Fock (1975) suggested that CCC induced in photosynthesis is associated with an increase in the enzyme activity and nucleic acid metabolism. It is generally believed that nitrate reductase activity depends on the activity of substrate and proteinaceous compounds and therefore it is suggested that the application of plant growth regulators results in the enhanced nitrate uptake by plants (Kuchenberg and Jung, 1988). Similarly, Goswami and Srivastava (1989) also reported increase in nitrate reductase activity due to the application of growth regulators.

The data on sugar content in cucumber fruits presented in Table 3 indicated significant differences among the treatments. The maximum reducing sugar (6.63) was recorded in GA3 @ 50 ppm and CCC @ 500 ppm. The minimum reducing sugar (0.51) was recorded in control which did not differ significantly with salicyclic acid @ 1000 ppm. Significantly higher non reducing (3.64) was also recorded in GA3 @ 50 ppm followed by CCC @ 250 and 500 ppm compared to all the treatments. The total sugar also followed a similar trend with GA3 @ 50 ppm recording maximum total sugar followed by CCC @ 500 ppm and control showing significantly minimum total sugar.

Table 1. Influence of plant growth regulators on chlorophyll a, b and total chlorophyll (mg g fresh wt-1) in leaves at different stages in cucumber

Treatments		Days after sowing (DAS)			Days after sowing (DAS)			Days after sowing (DAS)		
		40	55	70	40	55	70	40	55	70
T_1 -	GA_3 (50 ppm)	0.774	1.347	0.955	0.193	0.297	0.238	0.967	1.664	1.196
T_2 -	GA_3 (100 ppm)	0.772	1.282	0.937	0.165	0.285	0.221	0.937	1.567	1.158
T_3 -	NAA (50 ppm)	0.771	1.278	0.857	0.169	0.281	0.228	0.940	1.559	1.085
T_4 -	NAA (100 ppm)	0.772	1.315	0.875	0.182	0.294	0.221	0.954	1.609	1.096
T_5 -	CCC (250 ppm)	0.771	1.239	0.850	0.186	0.276	0.230	0.957	1.515	1.062
T_6 -	CCC (500 ppm)	0.772	1.242	0.838	0.190	0.260	0.206	0.962	1.502	1.044
T_7 -	Salicylic acid (500 ppm)	0.769	1.181	0.822	0.165	0.274	0.204	0.934	1.459	1.026
T_8 -	Salicylic acid (1000 ppm)	0.767	1.199	0.839	0.155	0.254	0.118	0.932	1.453	1.027
T_9 -	Control	0.769	1.160	0.816	0.154	0.240	0.184	0.923	1.400	1.000
	Mean	0.771	1.255	0.866	0.172	0.275	0.212	0.945	1.522	1.078
	S.Em±	0.002	0.022	0.026	0.002	0.002	0.003	0.003	0.020	0.020
	CD (5%)	NS	0.068	0.078	NS	0.008	0.009	NS	0.060	0.070

Table 2. Influence of plant growth regulators on nitrate reductase activity (nmol NO2 g. fr.wt.-1 hr-1hr-1) in leaves at different stages in cucumber

Treatments		Days after sowing (DAS)		
		40	55	70
T_1 -	GA_3 (50 ppm)	91.80	125.28	79.41
T_2 -	GA_3 (100 ppm)	91.62	121.76	77.53
T_3 -	NAA (50 ppm)	88.44	115.40	77.39
T_4 -	NAA (100 ppm)	88.36	117.02	76.37
T_5 -	CCC (250 ppm)	92.94	112.90	78.88
T_6 -	CCC (500 ppm)	95.98	119.16	79.02
T_7 -	Salicylic acid (500 ppm)	88.03	118.26	77.24
T_8 -	Salicylic acid (1000 ppm)	87.51	116.69	77.38
T_9 -	Control	84.85	114.62	75.41
	Mean	89.94	119.01	77.62
	S.Em±	0.58	1.41	0.82
	CD (5%)	NS	4.25	2.46

Table 3. Influence of plant growth regulators on reducing sugars, non reducing sugars and total sugars (mg g fresh wt-1) in fruits at harvest in cucumber

Treatments	Reducing sugars	Non reducing sugars	Total sugars

T_1 -	GA_3 (50 ppm)	0.63	3.64	4.27
T_2 -	GA_3 (100 ppm)	0.59	3.55	4.14
T_3 -	NAA (50 ppm)	0.57	3.41	3.98
T_4 -	NAA (100 ppm)	0.61	3.51	4.12
T_5 -	CCC (250 ppm)	0.61	3.57	4.18
T_6 -	CCC (500 ppm)	0.63	3.59	4.22
T_7 -	Salicylic acid (500 ppm)	0.58	3.56	4.14
T_8 -	Salicylic acid (1000 ppm)	0.53	3.53	4.06
T_9 -	Control	0.51	3.29	3.80
	Mean	0.58	3.52	4.10
	S.Em±	0.02	0.18	0.18
	CD (5%)	0.04	0.53	0.53

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