Using Carboxylic Enriched With Carboxylic Calcium, Algae Extract, and Glycine to Promote Yield and Fruit Quality of Williams Banana Plants

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Abstract: During 2016/ 2017 and 2017/ 2018 seasons, Williams banana plants were treated with carboxylic -Ca and glycine each at 0.1 % as well as Algae extract at 0.05 to 0.2% either singly or in all possible combinations. Plants received three sprays at the first week of May and at one month intervals. The objective was examining the impact of these materials on vegetative growth aspect, plant nutritional status, bunch weight and fruit characteristic of Williams banana plants. Subjecting Williams banana plants thrice with carboxylic -Ca and glycine each at 0.1% and Algae extracts at 0.05 to 0.2% singly or in combinations had considerable promotive effect on all growth aspects, N, P, K, Mg, bunch weight as well as all quality parameters. Using glycine was materially superior than using carboxylic -Ca in this respects. Using all materials together gave the best results. For promoting yield and fruit quality of Williams banana plants grown under Minia region conditions, it is suggested to use a mixture of Algae extract, carboxylic -Ca and glycine each at 01% thrice at are the first week of May and at one month intervals.
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1. Introduction

Many attempts were accomplised for promoting yield and fruit quality of Williams banana by using natural substances namely Algae extracts, carboxylic -Ca and glycine for avoiding our environment from pollution.

Amino acids as organic nitrogenous compounds are the building blocks in the synthesis of proteins, which are formed by as process in which ribosomes catalyze the polymerization of amino acids (**Davies, 1982**). Several hypothesis have been proposed the explain for the role of amino acids in plant. Available evidence suggests several alternative routes of IAA and ethylene synthesis in plants, starting from amino acids. In this respect, **(Taiz and Zeiger 2002**) suggested that the regulatory effect of certain amino acids like phenylalanine and ornithine in plant development appeared through their influence on the biosynthesis of gibberellins, tryptophan and methionine in building of I.A.A and ethylene respectively.

Calcium has been known as an essential element for trees for a long time and it has received much attention from the fertility standpoint and also very important for facilitating marketing of the fruits. Calcium is required for cell division and chromosome stability. As Ca-pectate, it is a constituent of the middle lamella of cell walls **(Dodd *et el*, 2010).** Calcium indirectly influences many enzyme systems such as amylase and ATPase. It also seems to have a regulating role in respiration and prolonging shelf life of fruits **(Marschner, 2010).**

One approach to increase crop yield is the developing of non polluting organic biostimulants. The application of Algae extract which contains most nutrients, organic compound, enzyme, vitamins, antioxidants, amino acids and natural hormones is fast becoming an accepted practice. It increases yield quantitatively and qualitatively in various fruit crops (**Soliman *et al.,* 2008 and Spinelli *et al.*, 2010**).

Using biofertilizer extracts nowadays for fruit crops has called the attention of research workers as an alternative to synthetic auxins and mineral N fertilization. They are very safe for human, animal and environment. Clean cultivation is greatly achieved by using biofertilizers or their exudates (**Kullk, 1995; Wani and Lee, 1995; Strick *et al,* 1997; Adam, 1999; Saffan-Samia, 2001; Tung-Yunn *et al,* 2003; and Ordog *et al.,* 2004**).

Previous studies showed that Algae **extract (Ebeid- Sanaa, 2007; El-Sawy,2008b, Gamal,2013, Mohamed, and El-Sehrawy,2013, Oraby,2013; Ahmed *et el* 2013; Ahmed *et el*, 2014; Eshmawy, 2015, Abd El-aaty,2015 and Ahmed *et el* 2015; Ca sources (joutamance *et el*, 2002, El-Shafey *et el* 2002, El-Tanany *et el*, 2004, Young Ho *et el*, 2004, Sarawy *et el*, 2012; Chakerolhasseini *et el*, 2016;**

Habasy- Randa *et el*,2016; Mohamrd *et el*,2017; Meena *et el*, 2017 and Hikal *et el*,2017 and amino acids (Ahmed *et el* 2014a; Ahmed *et el* 2014b, El-Khawaga, 2014, Hassan-Huda,2014, Sayed-Ola, 2014b and Mohamed,2016) were very effective in improving, growth, plant nutritional, status, yield and fruit quality of different fruit crops.

The target of this study was examining the effect of spraying Algae extract, Carboxylic -Ca and glycine on fruiting of Williams banana plants.

2. Material and Methods

This study was carried out during two successive seasons of 2016/ 2017 and 2017/ 2018 on third and fourth ratoons of Williams banana plants grown in a private fruit orchard situated at El-Gendia village at eastern bank of Bni Mazar city, Minia Governorate where the soil is silty clay and well drained and with a water table not less than two meters deep. The stools ate planted at 3.5 x 3.5 m apart. Surface irrigation system was followed.

The target of this study was examining the effect of spraying Algae extract, Carboxylic -Ca and glycine on fruiting of Williams banana plants.

Analysis of the tested soil at 0.0 to 90.0 cm depth was carried out according to the procedures that outlined by **Black (1965)** and the obtained data are shown in Table (1).

Table (1): Analysis of the tested soil

Constituents	Values
Particle size distributions	
Sand %	4.7
Silt %	60.0
Clay %	35.3
Texture	Silty clay
pH (1: 2.5 extract)	7.92
E.C. (1: 2.5 extract) (mmhos/1cm/25°C)	1.72
O.M. %	1.42
$CaCO_3$%	2.22
Total N %	0.09
Available P (ppm, Olsen)	5.2
Available K (ppm, ammonium acetate)	402.2

Horticultural practices such as fertilization with 25 tons farmyard manure (0.25 %N, 1.0% K2O and 0.4% P2O5); 2.25 tons ammonium nitrate (33.5 %N), one ton triple calcium superphosphate (37.5 % P_2O_5) and 1.5 tons potassium sulphate (48 % K_2O) per fed., irrigation with Nile water, hoeing as well as training, pest and fungi control were carried out as usual. Farmyard manure was added once at the mid of Jan. Ammonium nitrate was splitted into equal batches and added as two batches for each month started from fourteen April to October for each season. Potassium sulphate was divided into two equal batches applied before the emergence of the inflorescences and after fruit setting. Triple calcium superhosphate was added twice, the first with farmyard manure and the second before the emergence of the inflorescence.

This study included the following sixteen treatments from two factors (A & B). The first factor (A) comprised from the following four carboxylic – Ca and glycine treatments:

a_1) Non material
a_2) Carboxylic –Ca at 0.1%
a_3) Glycine at 0.1%
a_4) Both at 0.1%

The second factor (B) contained the following four Algae extract concentrations

b_1) 0.0 % (0.0 g/ L^{-1})
b_2) 0.05 % (0.5 g/ L^{-1})
b_3) 0.1 % (1 g/ L^{-1})
b_4) 0.2 % (2 g/ L^{-1})

Each treatment was replicated three times, one stool per each. Each stool contained three plants for fruiting in the current season plus three suckers for fruiting in the following season. Carboxylic -Ca, glycine and Algae extract were sprayed three times at the first week of May and at one month intervals. Triton B as a wetting agent was added to all solutions of Carboxylic -Ca, glycine and Algae extract. Chemical analysis of Algae extract are shown in table (2) (according to **James, 1994).**

Table (2): Analysis of Algae extract

Constituents	Values
Moisture %	6.0
O.M. %	45.6
Inorganic matter %	45.6
Proteins %	6.8
Carbohydrates %	5.5
Aliginic acid %	10.2
Mannitol %	4-7
Total N %	1.0 – 1.0
Total P%	0.02- 0.09
Total K %	1.0-1.2
Total Ca %	0.2- 1.5
Total S %	3-9
Total Mg %	0.5-0.9
Cu (ppm)	1.0-6.0
Fe (ppm)	50-200
Mn (ppm)	5-12
Zn (ppm)	10-100
B (ppm)	20-100
Mo (ppm)	1-5
Cytokinins %	0.02
IAA %	0.03
ABA %	0.03

This experiment was set up in a randomized complete Block design (RCBD) in split plot arrangement which the four Carboxylic -Ca concentrations and the four Algae extract concentrations occupied the main and sub- plots, respectively.

After the emergence of the inflorescence at the beginning of July for both the third and fourth ratoons, the following characteristic were determined.

1- Pseudostem height in (cm) was measured from the soil surface up to the petiole of the last emerged leaf.

2- Girth of pseudostem (cm) in the base, middle and top of pseudostem was recorded then the average was calculated.

3- Number of green leaves per plant was recorded.

4- Leaf area was recorded according to the following equation:-

LA = 0.67 (L x W) + 107.15 (**Ahmed and Morsy, 1999**) which L= leaf length (cm) and W = leaf width (cm)

5- Assimilation area $(m)^2$ was calculated by multiplying average leaf area by number of green leaves/ plant.

Leaf samples were taken from the third upper leaf in the descending leaves from the top of the plant after bunch shooting in September in the two seasons. A simple of 10x 10(cm) area from the middle part of the leaf blades as recommended by **Summer (1985)** was taken for mineral analysis. Leaf samples were washed several times with tap water then with distilled water after they were dipped in 0.1 NHCl Samples were oven dried at 60- 70 ^{o}C until a constant weight and then ground by using an electric mill. Weight of 0.5 gram of the ground material was digested using a mixture of perchloric acid: sulphoric acid (1: 10) (v/v) according to the **(Chapman and Pratt (1965)**. The clear digestion was quantitavely transferred to 100 ml volumetric flask. In this solution, the following nutrients were determined:

a) Total nitrogen was determined by using the micro- Kjeldahl method as described by **(Cottenie *et al.,* 1982).**

b) Phosphorus was determined by using the method of Olsen as report by **(Chapman and Pratt 1965).**

c) Potassium was determined by using Flame photometric, according to the method of (**wild *et el* (1985)**.

d) Magnesium was determined by using versene method (**Cottenie *et al.,* 1982**).

The bunches of both the third and fourth ratoons were picked at the middle of November in 2016/ 2017 and 2017/ 2018 seasons when the fingers reached three quarter stage. Bunch weight in kg (before artificial ripening),and average hand weight (g.) were recoded. Three hands were taken from the base middle and distal end of the bunch as a composite sample for the physical and chemical determination. Then, the chosen hands were wrapped with newspaper and arrested in closed wooden boxes with a glass surface to achieve artificial ripening and after the fingers ripened, the following physical determinations were carried out:

1- The weight of the finger (g) by using an analytical balance.

2- Fingers dimensions (diameter and length).

3- The weight of pulp and peel (g) by weighing the pulp and peel and expressed as a percentage from the finger weight.

4- The ratio between pulp and peel.

A composition fresh sample was taken from the pulp and mixed using an electric blender, then the following chemical constituents were determined:

1-Percentage of total soluble solids by using a handy refractometer.

2- Percentage of reducing, non reducing and total sugars as well as starch by using methods of **(Lane and Eynon 1965)** that outlined in **(A.O.A.C. 2000)**.

3- Percentage of total acidity (expressed as g malic acid per 100 g pulp) by using titration against 0.1 N sodium hydroxide and using phenolephthalein as an indicator **(A.O.A.C., 2000)**.

The obtained data were analyzed and the differences between different treatment means were compared using new L.S.D. test according to **(Mead *et al.*, 1993)**.

3. Results and Discussion

1-Effect of single and combine applications of carboxylic-Ca, glycine and Algae extract on some vegetative growth aspects:

Data in Tables (3 & 4) show the effect of single and combine applications of Ca, glycine and seaweed extract on pesudostem height and girth, number of green leaves /plant and leaf area of Williams banana plants during 2016/2017 and 2017/2018 seasons.

It is clear from the obtained data that subjecting the plants to calcium Ca and /or glycine each at 0.1% had signified promotion on the aforementioned growth traits rather the control. Using the amino acid namely glycine at 0.1% significantly surpassed. The application of Ca at 0.1% in enhancing the investigated characteristics. Using Ca in combined with glycine each at 0.1% significantly enhanced there growth attributes compared with using each singly. The maximum values were recorded due to using both materials together. Similar trend was noticed during both seasons.

It is clear from the obtained data that treating Williams banana plants with Algae extract at 0.05% to 0.2% significantly was accompanied with Algae extract at 0.05% to 0.2% stimulating the four growth aspects namely of leaves /plant and leaf area relative to the control (0.1% Algae extract). The promotion on three growth aspects was related to increase in Algae extract concentrations from 0.0 to 0.2 % significant differences on their growth aspects were recorded among all concentrations of Algae extract except among of the height two concentrations namely 0.1 and 0.2%.

The height values were recorded on the plants that received three sprays of Algae extract at 0.2%.

The lowest values were recorded on untreated plants. These resulted were true during both seasons.

Data in Tables (5 & 6) show that the interaction between Algae extract, Ca and glycine had significant effects on all vegetative growth aspects. The maximum values were recorded on the plants that received three sprays of a mixture of Algae extract at 0.2% plus Ca and glycine each at 01%.

Under each treatment the leaf area reached 1.41and 1.46 m^2 during both seasons, respectively. Control treatments gave the lowest values of leaf area (0.85 & 0.88 m^2) during both seasons, respectively the same trend was noticed during 2016/2017 and 2017/2018 seasons.

2-Effect of single and combine applications of carboxylic-Ca, glycine and Algae extract on N, P, K and Mg

Tables (5 & 6) show the effect of single and combine applications of Ca, glycine and Algae extract on the percentage of N, P, K and Mg in the leaves of Williams banana plants.

Concerting the effect of using Ca and/or glycine. The obtained data show that single and combined application of Ca- nitrate and glycine each at 0.1% significantly enhancing the percentage of N, P, K and Mg in the leaves relative to the control. Using glycine at 0.1 was significantly superior than using Ca at the same concentrations in enhancing these nutrients. Using both materials together significantly surpassed the application of each in this respect. Treating the plants with Ca and glycine each at 0.1% gave the maximum values. The untreated plants received the lowest values. Similar trend was noticed during both seasons.

Subjecting Williams banana plants to Algae extract at 0.05 to 0.2 % significantly was followed by enhancing the percentage of N, P, K and Mg in the leaves of Williams banana plants over the use of Algae extract at 0.0% there was gradual promotion on these nutrients with increasing concentrations of Algae extract from 0.0 to 0.2 %. Increasing concentrations of Algae extract from 0.1 to 0.2 % had no significant stimulations on these nutrients. The maximum values were recorded on the plants that received three sprays of Algae extract at 0.2%. The untreated plants produced the minimum values. These results were true during seasons.

All nutrients in the leaves (N, P, K, Mg) were significantly enhancing in response to using all materials (Algae extract, Ca and glycine) at the higher concentrations namely 0.2%,0.1 and 0.1 % respectively relative to the control The untreated plants gave the lowest values. These results were true during both seasons.

3-Effect of single and combine applications of carboxylic Ca, glycine and Algae extract on weights of bunch and hand;-

Data in Table (7) show the effect of single and combine applications of Ca, glycine and Algae extract on weights of bunch and finger of Williams banana plants.

Treating Williams banana plants with Ca and/or glycine each at 0.1 significantly improved weights of bunch and hand over the control. Using glycine was significantly favourable than using Ca in this respect. Using Ca in combined with glycine significantly improved weights of bunch and hand relative to the use of any material alone. The heaviest bunches and hands were receded on the plants that received Ca and glycine each at 0.1% together. The untreated plants received the highest bunch and hands. Similar trend was noticed during both seasons.

Spraying Algae extract at 0.05 to 0.2% significantly improved weights of bunches and hands over the check treatment. The promotion was in proportional to the increase in Algae extract concentrations. Meaningless promotion on weight of bunch and hand was observed with increasing concentrations of Algae extract concentrations from 0/1 to 0.2 %. Therefore from economical point of view it is suggested to use Algae extract at 0.1 %.

The untreated plants gave the lowest values. These results were true during both seasons.

The interactions all factors had significant promoitive effect on the weight of bunch and hand. From economical point of view it is suggested to use Algae extract besides Ca and glycine each at 0.1%. three times to produce the highest values of brunch and hand were 29.6 and 2.15 kg in the first season and 30.6 and 2.09 kg in the second season, respectively. The untreated plants produced 21.0 and 1.29 kg during 2016/2017 season and 20.0 and 1.31 kg during 2017/2018 season, respectively. The percentage of increment on the average bunch weight and hand weight over the control.

In the first season reached 42.4 and 66.7% and in the second one reached 53.0 and 54.5% respectively. These results were true during both.

4-Effect of single and combine applications of carboxylic-Ca glycine and Algae extract on some physical and chemical characteristics of the fruit of Williams banana plants:-

Data in tables (98to13) Show the effect of single and combine applications of Ca, glycine and Algae extract on some physical and chemical characteristics of the finger weight, length and width, fruit pulp and peel %, pulp/peel, starch %,T.S.S %, reducing, total and non-reducing sugars % and titrilable acidity of the fruit of Williams banana plants.

Treating Williams banana plants with Ca and /or glycine each at 0.1significalty was very effective in improving fruit quality in terms of increasing fingers weight and dimensions (length & width), fruit pulp%, T.S.S%, total, reducing and non-reducing sugars and decreasing fruit peel weight%; starch % and titratible acidity % relative to the control.

Using glycine was significantly favourable than using Ca in enhancing fruit quality. Combined applications of Ca and glycine each at 0.15 gave the best results with regard. To fruit quality than using each alone. Unfavourable effect on fruit quality was attributed to unsparing these materials. Similar trend was noticed during 2016/2017 & 2017/2018 seasons.

It is evident from the obtained data that fruit was significantly improved in response to treating the tress three times with Algae extract at 0.05 to 0.2 % over the control. This promotion was significantly appeared in terms of increasing weight, length and width of fruit pulp %, T.S.S %, total, reducing and non- reducing sugars and decreasing fruit peel weight%; starch % and titratible acidity.

The promotion on fruit quality was associated increasing concentration of Algae extract. Significantly different parameters were observed among all concentrations except among all height two concentrations namely 0.1% and 0.2%. The untreated produced undesirable effects on fruit quality. Similar results were announced during 2016/2017 and 2017/2018 seasons.

It is obvious from the obtained data that fruit quality parameters was significantly varied among all the combinations of the investing treatment. The best results with regarded to fruit quality were obtained due to treating the plants three times with a mixture of Algae extract at 0.2 % as well as glycine and Ca due at 0.1%. The plants treated with Algae extract, Ca and glycine each at 0.0%. These results were true during both seasons.

Table (3):- Effect of single and combined applications of Ca, glycine and Algae extract extracts on The number of green leaves /plant and leaf area (m^2) of Williams banana plants during 2016/2017 and 2017/2018 seasons.

The number of green leaves /plant										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae}at 0.0%	12.0	14.0	16.0	18.0	15.0	13.0	15.0	17.0	20.0	16.3
b_2 Algaeat 0.05%	13.0	16.0	18.0	20.0	16.8	15.0	18.0	21.0	23.0	19.3
b_3 Algaeat 0.1%	16.0	18.0	20.0	24.0	19.5	17.0	20.0	24.0	25.0	21.5
b_4 Algaeat 0.2%	16.0	18.0	20.0	24.0	19.5	17.0	20.0	24.0	25.0	21.5
Mean (A)	14.3	16.5	18.5	21.5		15.5	18.3	21.5	23.3	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		1.0	1.0	2.0			1.0	1.0	2.0	
	leaf area (m^2)									
Algae extract Treatment (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae} at 0.0%	0.85	0.96	1.06	1.18	1.01	0.88	0.99	1.10	1.23	1.05
b_{2Algae} at 0.05%	0.98	1.10	1.20	1.31	1.15	1.01	1.14	1.25	1.35	1.19
b_3Algae at 0.1%	1.08	1.21	1.33	1.40	1.26	1.11	1.25	1.40	1.45	1.30
b_4Algae at 0.2%	76.1	1.09	1.22	1.34	1.41	1.12	1.26	1.40	1.46	1.31
Mean (A)	1.00	1.12	1.23	1.33		1.03	1.16	1.29	1.37	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		1.0	0.04	0.08			0.07	0.06	0.12	

Table (4):- Effect of single and combined applications of Ca, glycine and Algae extract extracts on pseudo stem height (cm) and Pseudo stem girth (cm) of Williams banana plants during 2016/2017 and 2017/2018 seasons

pseudo stem height (cm)										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)
b_1 Algaeat 0.0%	1.58	1.79	1.99	2.20	1.89	1.69	1.84	2.05	2.25	1.95
b Algaeat 0.05%	1.76	1.99	2.22	2.51	2.13	1.85	2.04	2.25	2.45	2.15
b_3 Algaeat 0.1%	2.00	2.21	2.50	2.72	2.36	2.07	2.25	2.45	2.65	2.36
b_4 Algaeat 0.2%	2.05	2.22	2.51	2.74	2.38	2.10	2.26	2.46	2.66	2.37
Mean (A)	1.83	2.03	2.31	2.54		1.42	2.09	2.30	2.50	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.16	0.14	0.28			0.18	0.15	0.30	

	Pseudo stem girth (cm)									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)
b_1 Algae at 0.0%	73.9	75.0	76.1	77.4	75.6	74.0	75.9	77.3	79.0	76.6
b_2 Algae at 0.05%	74.9	76.1	77.5	79.0	76.9	76.1	77.9	79.9	82.0	79.0
b_3 Algae at 0.1%	76.0	78.0	79.1	81.0	78.5	77.4	79.4	81.4	84.0	80.6
b_4 Algae at 0.2%	76.1	78.3	79.3	81.9	78.9	77.5	79.5	81.7	84.5	81.0
Mean (A)	75.2	76.9	78.0	79.8		76.3	78.2	80.1	82.4	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		1.0	0.8	1.6			1.1	0.9	1.8	

Table (5):- Effect of single and combined applications of Ca, glycine and Algae extract extracts on The percentage of N and P in The leaves of Williams banana plants during 2016/2017 and 2017/2018 seasons

Leaf N %										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)
b_1 Algae at 0.0%	2.41	2.53	2.66	2.80	2.60	2.40	2.55	2.68	2.82	2.61
b_2 Algae at 0.05%	2.55	2.71	2.84	2.99	2.77	2.58	2.74	2.87	3.01	2.80
b_3 Algae at 0.1%	2.71	2.86	2.99	3.14	2.93	2.74	2.89	3.01	3.18	2,96
b_4 Algae at 0. 2%	2.72	2.87	2.99	3.15	2.93	2.75	2.90	3.02	3.19	2.97
Mean (A)	2.60	2.74	2.87	3.02		2.62	2.77	2.90	3.05	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.07	0.06	0.12			0.06	0.07	0.14	

	Leaf P %									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)	a_1 Non	a_2 Carboxylic Ca 0.1%	a_3 Glycine 0.1%	a_4 Both Carboxylic Ca & glycine	Mean (b)
b_1 Algaeat 0.0%	0.19	0.28	0.36	0.44	0.32	0.17	0.29	0.37	0.43	0.32
b_2 Algae at 0.05%	0.28	0.36	0.45	0.56	0.41	0.29	0.37	0.46	0.57	0.42
b_3 Algaeat 0.1%	0.36	0.44	0.50	0.64	0.44	0.36	0.43	0.50	0.64	0.48
b Algae at 0.2%	0.37	0.45	0.50	0.64	0.49	0.38	0.44	0.51	0.65	0.50
Mean (A)	0.30	0.38	0.45	0.57		0.30	0.38	0.46	0.57	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.05	0.04	0.08			0.03	0.03	0.06	

Table (6):- Effect of single and combined applications of Ca, glycine and Algae extract extracts onbunch weight (kg) / plant and hand weight (kg) of Williams banana plants during 2016/2017 and 2017/2018 seasons

Bunch weight (kg) / plant										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae} at 0.0%	21.0	22.5	24.0	23.5	23.3	20.0	23.0	24.6	26.0	23.4
b_{2Algae} at 0.05%	22.6	24.0	25.9	28.0	25.1	23.1	24.6	26.5	28.7	25.7
b_3 Algae at 0.1%	24.0	25.7	27.1	29.6	26.6	24.6	26.2	27.9	30.6	27.3
b_{Algae} at 0.2%	24.2	26.0	27.5	29.9	26.9	24.7	26.4	28.0	30.7	28.2
Mean (A)	23.0	24.6	26.1	28.3		23.1	25.1	26.8	29.0	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.6	0.7	1.4			0.6	0.6	1.2	
	Hand weight (kg)									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae} at 0.0%	1.29	1.42	1.55	1.71	1.49	1.31	1.46	1.59	1.75	1.53
b Algae at 0.05%	1.42	1.55	1.71	1.90	1.65	1,47	1.60	1.75	1.95	1.69
b_{3Algae} at 0.1%	1.55	1.72	1.86	2.15	1.82	1.60	1.76	1.90	2.09	1.84
b_4 Algae at 0.2%	1.56	1.73	1.90	2.16	1.84	1.61	1.77	1.91	2.11	1.85
Mean (A)	1.46	1.61	1.76	1.98		1.50	1.65	1.79	1.98	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.07	0.06	0.12			0.05	0.05	0.10	

Table (7):- Effect of single and combined applications of Ca, glycine and Algae extract on Fruit weight (g) and fruit length (cm) of Williams banana plants during 2016/2017 and 2017/2018 seasons

Fruit weight (g)										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_1 Algaeat 0.0%	88.0	90.0	92.1	95.0	91.3	90.0	91.2	93.2	96.2	92.7
b Algae at 0.05%	90.5	92.9	95.0	97.5	94.0	91.5	94.0	96.2	99.0	95.2
b_{3Algae} at 0.1%	93.0	95.1	98.0	100.0	96.5	94.1	96.2	99.2	99.3	97.2
b_{4Algae}at 0.2%	93.3	95.2	98.3	100.6	96.9	94.1	96.3	99.3	99.5	97.3
Mean (A)	91.2	93.3	95.9	98.3		92.4	94.4	97.0	98.5	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		1.1	0.9	1.8			1.0	1.0	2.0	
	Fruit length (cm)									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_1 Algae at 0.0%	14.9	15.01	15.13	12.26	15.08	15.00	15.12	15.31	15.44	15.22
B2 Algae at 0.0%	15.30	15.70	16.00	16.12	15.61	15.60	15.75	16.10	16.25	15.93
B3 Algae at 0.0%	15.60	16.00	16.13	16.26	16.00	15.80	16.05	16.22	16.33	16.10
b_{4Algae} at 0.0%	15.62	16.03	16.14	16.27	16,02	15.81	16.06	16.24	16.34	16.11
Mean (A)	15.36	15.69	15,85	15.98		15.55	15.75	15.97	16.09	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.06	0.05	0.10			0.06	0.04	0.08	

Table (9):- Effect of single and combined applications of Ca, glycine and Algae extract Finger width (cm) and The percentage of fruit pulp %) of Williams banana plants during 2016/2017 and 2017/2018 seasons

Finger width (cm)										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae} at 0.0%	7.81	7.91	8.2	8.12	7.97	7.76	7.90	8.05	8.20	7.98
b_{2s} Algae at 0.05%	7.92	8.04	8.24	8.50	8.18	7.91	8.09	8.30	8.50	8.20
b_3 Algaeat 0.1%	8.03	8.26	8.70	8.71	8.35	8.09	8.33	8.50	8.71	8.41
b_{4Algae}at 0.2%	8.04	8.28	8.41	8.72	8.36	8.10	8.34	8.51	8.72	8.42
Mean (A)	7.95	8.12	8.27	8.51		7.97	8.17	8.34	8.53	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.05	0.05	0.10			0.06	0.05	0.10	
	Percentage of fruit pulp %									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae}at 0.0%	73.11	73.66	74.15	74.60	73.88	73.31	74.00	74.50	75.80	74.40
b_{2Algae} at 0.0%	73.70	74.5	75.0	76.0	74.80	73.90	74.91	75.81	76.81	75.38
b_{3Alga}at 0.0%	74.11	75.91	76.90	77.77	76.17	74.31	76.81	77.82	79.82	77.19
b_{4Algae} at 0.0%	74.12	75.92	76.91	77.75	76.18	74.32	76.83	77.83	79.85	77.21
Mean (A)	73.76	75.00	75.74	76.54		73.96	75.64	76.49	78.06	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.21	0.19	0.38			0.23	0.20	0.40	

Table (8):- Effect of single and combined applications of Ca, glycine and Algae extract on The percentage of fruit peels and The pulp /peel in finger of Williams banana plants during 2016/2017 and 2017/2018 seasons

Fruit peal %										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Alga}at 0.0%	26.89	26.34	25.83	25.40	26.12	26.69	26.00	25.50	24.20	23.60
b_{2Algae} at 0.05%	26.30	25.50	25.00	24.00	25.20	26.00	25.09	24.19	23.19	24.62
b_{3Algae}at 0.1%	25.89	24.09	23.10	22.23	23.0	25.69	23.19	22.18	20.18	22.81
b_{4Algae}at 0.2%	25>85	24>08	23.09	22.22		25.68	23.18	22.17	20.15	22.80
Mean (A)	26.24	25.00	24.26	23.46		26.02	24.37	23.50	21.93	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.22	0.20	0.40			0.20	0.18	0.36	
	Pulp/Peel of finger									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae} at 0.0%	2.72	2.80	2.87	2.94	2.83	2.75	2.85	2.92	3.13	2.91
B_{2Algae} at 0.05%	2.80	2.92	3.00	3.17	2.97	2.83	2.99	3.13	3.31	3.07
B_{3Algae}at 0.1%	2.86	3.15	3.33	3.50	3.21	2.89	3.31	3.51	3.96	3.42
B_{4Algae} at 0.2%	2.86	3.15	3.33	3.50	3.21	2.89	3.31	3.51	3.96	3.42
Mean (A)	2.81	3.01	3.13	3.28		2.84	3.12	3.27	3.59	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.05	0.04	0.08			0.05	0.05	0.10	

Table (9):- Effect of single and combined applications of Ca, glycine and Algae extract on The percentage of starch and The T.S.S % in The pulp of Williams banana plants during 2016/2017 and 2017/2018 seasons

Starch %										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Alga}at 0.0%	1.62	1.50	1.38	1.25	1.44	1.66	1.50	1.35	1.20	1.43
$b_{2sAlgae}$ at 0.0%	1.49	1.25	1.12	0.99	1.21	1.49	1.35	1.20	1.03	1.27
b_{3Algae}at 0.0%	1.36	1.12	0.99	0.85	1.08	1.29	1.03	0.90	0.77	1.01
b_{4Algae}at 0.0%	1.35	1.11	0.98	0.84	1.07	1.29	1.02	0.88	0,76	0.99
Mean (A)	1.46	1.25	1.12	0.98		1.43	1.23	1.10	0.94	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0,07	0.06	0.12			0.05	0.06	0.12	
	T.S.S %									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae}at 0.0%	18.11	18.41	18.85	19.20	18.54	18.20	18.50	18.94	19.30	18.74
$b_{2seaweed}$ at 0.05%	18.50	19.00	19.50	20.00	19.25	18.61	19.10	19.60	20.11	19.36
b_{3Algae} at 0.1%	19.00	19.49	20.00	20.25	19.69	19.10	19.60	20.20	20.50	19.85
$b_{4Algae\ Algae}$ at 0.2%	19.04	19.50	20.01	20.27	19.71	19.11	19.61	20.22	20.52	19.87
Mean (A)	18.72	19.24	19.85	21.57		18.76	19.13	19.74	20.11	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.10	0.09	0.18			0.11	0.10	0.20	

Table (10):- Effect of single and combined applications of Ca, glycine and Algae extract on The percentage of total and reducing sugars in % in The pulp of Williams banana plants during 2016/2017 and 2017/2018 seasons

Total sugars %										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae} at 0.0%	15.11	15.35	15.60	15.85		15.20	15.44	15.70	15.95	
$b_{2sAlgae}$ at 0.05%	15.36	15.60	15.86	16.20		15.46	15.87	15.87	16.30	
b_{3Algae} at 0.1%	15.60	15.86	16.30	16.60		15.71	15.96	16.39	16.69	
b_{4Algae} at 0.2%	15.61	15.87	16.31	16.61		15.72	15.97	16.40	16.70	
Mean (A)										
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.14	0.12	0.24			0.12	0.11	0.22	
	Reducing Sugars %									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4		a_1	a_2	a_3	a_4	
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	Mean (b)
b_{1Algae} at 0.0%	5.01	5.16	5.32	5.50		4.99	5.20	5.36	5.55	
b_{2Algae} at 0.05%	5.17	5.33	5.50	5.66		5.21	5.37	5.55	5.71	
$b_{3Algae\ extract\ extracts}$ at 0.1%	5.35	5.55	5.71	5.91		5.40	5.60	5.76	5.96	
$b_{4AlgaeAlgae}$ at 0.2%	5.36	5.56	5.72	5.92		5.41	5.61	5.77	5.97	
Mean (A)										
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.09	0.07	0.14			0.08	0.06	0.12	

Table (11):- Effect of single and combined applications of Ca, glycine and Algae extract on The percentage of non-reducing sugars and titratable acidity in The pulp of Williams banana plants during 2016/2017 and 2017/2018 seasons

Non-reducing sugars %										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae} at 0.0%	10.10	10.19	10.28	10.35	10.23	10.21	10.24	10.34	10.40	10.25
b_{2Algae} at 0.0%	10.19	10.27	10.36	10.54	10.34	10.25	10.34	10.32	10.59	10.38
b_{3Algae} at 0.0%	10.25	10.31	10.59	10.69	10.46	10.31	10.36	10.63	10.73	10.51
b_{4Algae} at 0.0%	10.25	10.31	10.59	10.69	10.46	10.31	10.36	10.63	10.73	10.51
Mean (A)	10.20	10.27	10.46	10.57		10.27	10.33	10.48	10.61	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.06	0.04	0.08			0.03	0.04	0.08	
	Titratable acidity %									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae} at 0.0%	0.399	0360	0.330	0.300	0.347	0.401	0.359	0.339	0.299	0.347
b_{2Algae} at 0.05%	0.360	0.330	0.300	0.200	0.314	0.358	0.329	0.298	0.265	0.313
b_{3Algae} at 0.1%	0.330	0.300	0.260	0.230	0.280	0.329	0.299	0.257	0.228	0.278
b_{4Algae} at 0.2%	0.329	0.299	0.259	0.228	0.278	0.328	0.298	0.256	0.227	0.277
Mean (A)	0.355	0.322	0.287	0.255		0.353	0.321	0.285	0.254	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.014	0.015	0.030			0.016	0.014	0.028	

Table (12):- Effect of single and combined applications of Ca, glycine and Algae extract extracts on The percentage of K and Mg of Williams banana plants during 2016/2017 and 2017/2018 seasons

Leaf K %										
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae}at 0.0%	2.79	2.90	3.01	3.12	2.96	2.74	2.91	3.02	3.13	
$b_{2sAlgae}$ at 0.0%	2.91	3.05	3.16	3.30	3.11	2.91	3.06	3.16	3.29	
$b_{3Algae\ extract\ extracts}$ at 0.0%	3.03	3.20	3.30	3.42	3.24	3.06	3.25	3.35	3.46	
b_{4Algae} at 0.0%	3.04	3.20	3.31	3.43	3.25	3.07	3.26	3.35	3.46	
Mean (A)	2.94	3.09	3.12	3.32		2.95	3.12	3.22	3.24	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.06	0.05	0.10			0.05	0.06	0.12	
	Leaf Mg %									
Algae extract Treatments (B)	Ca and glycine treatments (A)									
	2016/2017					2017/2018				
	a_1	a_2	a_3	a_4	Mean (b)	a_1	a_2	a_3	a_4	Mean (b)
	Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine		Non	Carboxylic Ca 0.1%	Glycine 0.1%	Both Carboxylic Ca & glycine	
b_{1Algae} Algaeat 0.0%	0.41	0.48	0.56	0.70	0.54	0.37	0.51	0.59	0.71	0.55
$b_{2sAlgae}$ at 0.05%	0.50	0.61	0.66	0.76	0.63	0.52	0.64	0.70	0.81	0.67
b_{3Algae} at 0.1%	0.57	0.71	0.76	0.83	0.72	0.61	0.75	0.85	0.96	0.79
b_{4Algae} at 0.2%	0.58	0.72	0.77	0.84	0.73	0.62	0.76	0.86	0.98	0.81
Mean (A)	0.53	0.63	0.69	0.78		0.53	0.67	0.75	0.87	
		A	B	AB			A	B	AB	
New L.S.D at 5 %		0.04	0.03	0.06			0.06	0.05	0.70	

4. Discussion

1- Effect of amino acids:-

Amino acids as organic nitrogenous compounds are the building blocks in the synthesis of proteins, which are formed by as process in which ribosomes catalyze the polymerization of amino acids (**Davies, 1982**). Several hypothesis have been proposed the explain for the role of amino acids in plant. Available evidence suggests several alternative routes of IAA and ethylene synthesis in plants, starting from amino acids In this respect, **(Taiz and Zeiger 2002**) suggested that the regulatory effect of certain amino acids like phenylalanine and ornithine in plant development appeared through their influence on the biosynthesis of gibberellins, tryptophan and methionine in building of I.A.A and ethylene respectively. These results are in agreement with those obtained by **Ahmed *et el* (2014); El-Khawaga, (2014), Hassan-Huda, (2014); Sayed-Ola,2014 and Mohamed (2016).**

2- **Effect of Calcium:_**

Calcium has been known as an essential element for trees for a long time and it has received much attention from the fertility standpoint and also very important for facilitating marketing of the fruits. Calcium is required for cell division and chromosome stability. As Ca-pectate, it is a constituent of the middle lamella of cell walls **(Dodd *et el*,2010).** Calcium indirectly influences many enzyme systems such as amylase and ATPase. It also seems to have a regulating role in respiration and prolonging shelf life of fruits **(Marschner, 2010).** **The results of Joutamance et el (2002); El-Shafey *et el* (2002); El-Tanany et el (2004) Young Ho et el (2004); Sarawy et el (2012); Chakerolhasseini et el,2016; Habasy- Randa et el (2016); Mohamrd et el (2017); Meena *et el* (2017) and Hikal et el (2017) supported the present results.**

3- Effect of Algae extract

The application of Algae extract which contains most nutrients, organic compound, enzyme, vitamins, antioxidants, amino acids and natural hormones is fast becoming an accepted practice. It increases yield quantitatively and qualitatively in various fruit crops (**Soliman *et al.,* 2008 and Spinelli *et al.,* 2010**).

These results are in agreement with those obtained by **Ebeid- Sanaa,2007); El-Sawy,2008), (Gamal,2013) (Mohamed and, El-Sehrawy, (2013b); Oraby, (2013a); Ahmed *et el*, (2014); Eshmawy, (2015); Abd El-aaty,2015) and Ahmed *et el* (2015).**

Conclusion

For promoting yield and fruit characteristics of Williams banana grown under Minia region conditions, it is suggested to use a mixture of carboxylic -Ca and glycine plus Algae extract each at 0.1% three times a year at the first week of May and at one month intervals.

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