Journal

J. Biol. Chem. Environ. Sci., 2018, Vol. 13(4): 145-160
http://biochemv.sci.eg

AMELIORATE OF GROWTH AND PRODUCTION OF GARLIC BY GYPSUM AND CYANOBACTERIA UNDER ALKALOID SOIL CONDITION

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ABSTRACT

A field experiment was carried out at Sakha Horticulture Research Station farm, Kafr El- Sheikh Governorate, North Delta, Egypt, during two winter seasons of 2015/2016 and 2016/2017. The research aimed to study the effect of different gypsum levels (0، 4 and 8 ton fed^{-1}) with or without inoculated cyanobacteria on local garlic growth, yield and its components as well as impact on some alkaline soil properties. The experiment was carried out in a complete randomized block design with three replications. The obtained results indicated that inoculation with cyanobacteria plus 8 ton fed^{-1}gypsum attained a highly significant response for increased vegetative growth characters i.e. the highest leaves number, plant height, plant dry weight compared to control (without any addition) in both seasons. Furthermore, bulb yield and its components as well as chemical constituents had a similar trend with application of cyanobacteria+8 ton gypsum per fed. Also the results showed that the amendments addition clearly improved some chemical and physical properties of the studied soil.

INTRODUCTION

Garlic (*Allium Sativum* L.) is one of the important members of Alliaceae family and belonging to the genus *Allium*. It is one of the most important bulb vegetable crops as well as it is next to onion in the importance **(Kamenetsky, 2007 and Hamma *et al.*, 2013).** It is broadly among the oldest cultivated plants, and it's used both as a food and for medicinal applications (**Satyal *et al.*, 2017**). In fact, it's used for food flavoring, and also are rich source of several phytonutrients recognized as important elements of the Mediterranean diet, but are also used in the treatment and prevention of a number of diseases, like cancer, obesity, coronary heart disease (**Keusgen, 2002; Virginia**, **2006 and Lanzotti *et al.*, 2014**).

Production and cultivated area of world have increased over years, where garlic is grown all over the world from temperate to subtropical climates (**Fritsch and Friesen, 2002**). It is a high value cash crop due to its various used in local consumption, food processing and exportation (**El eshmwiy *et al.*, 2010**). In 2016 world production was 26573001 ton., the main producer of garlic is China, with 21635005 ton, Egypt ranks fifth in production of garlic in the world, with total yield of 1272769 ton.(**FAO, 2017**).

Alkaline soil has an abundance of sodium carbonate that reacts with water and gives high pH values. These soils are sticky when wet but become hard, cloddy, and crusty when dry. Growth of plants affected mainly in the alkaline soil due to nutritional imbalance, restricted root system, excess of chloride and sodium, excess hydroxyl and carbonate ions (**Rao and Maddaiah, 2010).** Therefore gypsum (calcium sulphate, CaSO4. 2H2O) can applied as a source of Ca^{++} ions to replace the sodium at the exchange complex. Also, calculation of gypsum requirement for reducing the sodium exchange of alkaline soils **(Patel and Damor, 2015; ICAR-CSSRI, 2016; Dorivar** and **DeAnn, 2017).** Moreover owing to its accessibility, low-price and easy of handling (**Amezketa *et al.*, 2005**).

Work in South Africa on corn has shown yield benefits when gypsum was applied to help overcome subsoil acidity problems (**Farina *et al.*, 2000a and 2000b**). A report by **Dick *et al.*, (2006)** summarizes 20 different potential agricultural and other land application uses of gypsum. Gypsum has been used to enhance the yield and quality of some horticultural crops. For example, gypsum decreases storage rots of cantaloupe and tomato (**Sumner and Larrimore, 2006; Scott *et al.*, 1993**).

Cyanobacteria (Blue Green Algae) can impact plant growth by different ways, direct ways include producing of various plant growth promoting biologically active substances including phytohormones, such as gibberellins, auxin and cytokinins (**Rodriguez *et al*., 2006; Hussain and Hasnain, 2009 and Prasanna *et al.*, 2010**). Also cyanobacteria can inhibitor deleterious effects of one or more phytopathogenic microorganisms (**Tassara *et al*., 2008; Kim and Kim, 2008**). The capacity for biosynthesis of growth promoting substances like auxins, amino acids, vitamins and/or many other components that enhance plant growth were reported by **De Mule *et al*., (1999)** and **Abdel-Raouf *et al*., (2012).**

Cyanobacteria have a unique potential to contribute to nitrogen fixing and build-up soil fertility as biofertilizer for plants, consequently increasing the productivity **(Palaniappan *et al*., 2010). Eletr, *et al*., (2013)** indicated that applying cyanobacteria inoculation in combined with some soil conditioners decreased slightly pH, EC, SAR and ESP values, while organic matter (OM) and saturation percent (SP) were increased and positive significant responses existed of available N, P and K as compared to control treatment. Also, cyanobacteria inoculation combined with gypsum improved available and uptake of macronutrients reflected on the yield components**.**

The objective of the present study is to investigate the effect of gypsum levels with or without cyanobacteria on local garlic growth, yield and its components under alkaline soil condition.

MATERIALS AND METHODS

The present study was carried out at farm of Sakha Horticulture Research Station, Kafr El Sheikh Governorate, Egypt, in two winter seasons of 2015/2016 and 2016/2017. This study was conducted to investigate the effect of gypsum levels with or without inoculated cyanobacteria on garlic growth, yield and its components. The experimental location was in the middle Northern of Nile Delta in along the western branch of Nile River**.** The site altitude of about 6 meters above mean sea level and it lies at 30.57 N. Latitude, 31.07 E. Longitudes. Surface soil samples (0-30cm) from the experimental field were analyzed as shown in **Table (1).**

Table (1) Soils physical & chemical properties prior to treatment application.

Particle Size Distributions (%)			Textural Class	Hydraulic Conductivity cm^2 / hour	S.P (%)	Bulk density g/cm3	Porosity (%)	Structure Factor	
Clay	Silt	Sand							
57.85	26.9	15.25	Clayey	2.43	41.8	1.29	46.69	20.9	
E.C dSm-1 (1:5)	Soluble Cations (cmol L-1) (1:5)				Soluble Anions (cmol L-1) (1:5)				SAR
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO3	HCO3	Cl	SO4	
3.9	4.9	2.8	30.6	0.4	0	0.8	28.1	9.8	15.61
pH Sus. S:W (1:2.5)	CaCO3 (%)	Organic matter (%)	Exchangeable Cations (cmol kg-1 soil)				C.E.C cmol kg-1 soil	ESP	Gypsum Requirement (Mg fed-1)
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}			
8.65	4.3	1.44	15.25	22.3	9.18	3.77	51.3	17.9	6.97

Cyanobacteria (Nostoc sp. & Anabaena sp.) was kindly provided by biofertilizers Production Unit; Soils, Water and Environment Research Institute, ARC, Giza, Egypt. It was prepared as inoculants on suitable sterilized carrier, packed into polyethylene (400g), the content of bag is 10^9 CFU/g. for inoculant.

The experiment was set up in Complete Randomized Block (RCB) design at 6 treatments with three replications. The treatments included three levels of gypsum (G.) 0, 4 and 8 ton fed^{-1} with or without inoculant cyanobacteria. The following treatments were conducted:

(1) Control [without gypsum or cyanobacteria].
(2) Cyanobacteria (400 g fed^{-1}).
(3) 4 ton fed^{-1} G.
(4) 8 ton fed^{-1} G.
(5) Cyanobacteria (400g fed^{-1}) + 4 ton fed^{-1} G.
(6) Cyanobacteria (400g fed^{-1}) + 8 ton fed^{-1} G.

Each experimental plot includes six ridges 5 m length and 70 cm width with an area 21 m^2. The cloves of cv. Balady were planted on October 10^{th} and 15^{th} for the first and second. All agronomic practices such as land preparation and fertilization as well as irrigation were done as recommended to assure optimum production. The observations on growth parameters like plant height and number of leaves were recorded at 100 days after planting (DAP). The bulb of garlic was harvested on 10^{th} May, for two seasons at it was fully matured.

Soil Analysis

***Particle size distribution** was estimated according to the pipette method of **piper (1950)**

***Bulk density**, **Total porosity, Permeability** were determined according to **black *et al.,* (1982-1)**, Electrical conductivity **(E.C)** in a 1: 5 soil–water extracts was determined using ICM M71100 EC-meter, Soluble cations and anions (Ca, Mg, K, Na, CO3, HCO3 and Cl) were detected in 1: 5 soil-water extracts While**,** soluble sulphate was calculated by subtracting total soluble cations from total soluble anions. Cations exchange capacity **(C.E.C)** was determined by using (1N) sodium acetate method (pH 8.2). However, exchangeable cations were determined using (1N) ammonium acetate (pH 7.0) and Gypsum requirements were described by **Richards (1954).**

***Structure factor** was determined according to **Black *et al* (1982-I)** While, Gypsum content in soil was determined according to **Black *et al* (1982) part (ll)**

***Soil reaction** (pH) was determined in (1: 2.5) soil water suspention by using Orion 420 pH-meter and organic matter content was determined using the modified Walkly and Black's titration method as described by **Black *et al.,* (1982-1)**

***Available nitrogen** determined using 1N (K_2SO_4) extract method and **available potassium** determined using 1N (NH_4OAC) extract method, these analyses were carried out as described by **Jackson (1973).**

Available phosphorus was extracted and determined by using 0.5N ($NaHCO_3$ at pH 8.5) as described by **Olsen (1982).**

Plant data recorded:

A. Vegetative characters of garlic plants:

1. Leaves number plant^{-1}: All visible leaves were counted except the dry and undifferentiated ones which excluded.

2. Plant height (cm): were taken randomly from average of ten plants.

B. Total yield and bulb qualities of garlic plants:

1. Total Yield: After harvesting, the yield of each plot was left in the farm as intact plant (with tops and roots) for fifteen days until the curing process was completed. After wards the yield was weighted and expressed as ton per feddan.

2. Bulb diameter (cm): Average bulb diameters (5 bulbs) in each treatment were measured in centimeters.

3. Bulb weight (g): Total bulbs weight (5 bulbs) in each treatment was calculated in grams by the use of the following equation:

$$\text{Average bulb weight} = \frac{\text{Total weigth of bulbs}}{\text{Total number of bulbs}}$$

4. Average of clove weight (g).

5.Plant dry weight(g):after drying to a constant weight at700 C.

Chemical characters:

Total nitrogen: Total nitrogen in plant material was determined using Kjeldahl method according to **Chapman and Pratt (1961).**

Total phosphorus: Total phosphorus was determined by using stannous chloridemolybdate method and measured colormetrically according to **Jackson (1973).**

Total potassium: Total potassium was determined using flame photometer according to **Jackson (1973).**

Nutrients Uptake (N, P and K uptake**):** Based on the nutrient concentration in plants the uptake of nitrogen, phosphorus, and potassium was worked out by multiplying dry matter content with respective nutrient concentration in plant samples.

Total protein: Total protein in plant was determined using the calculation of total nitrogen by multiplying 5.7 **(A. O. A. C., 2005).**

Total carbohydrate: Total carbohydrate in plant material was determined according to **Dubois (1956)**

Statistical analysis :

The obtained data were submitted to analysis of variance according to the method described by **Gomez and Gomez (1984).** Treatment means were compared by Duncan's Multiple Range Test (**Duncan, 1955**).

RESULTS AND DISCUSSION

1. Soil physio-chemical properties:

The data obtained for the amended soil with gypsum with or without inoculated cyanobacteria and subjected to cultivation management are given the changes of some soil physio-chemical properties, **Table (2).**

Table 2: Effect of gypsum levels and cyanobacteria on some physio-chemical properties.

Treatments	S.P* (%)	S.F**	pH (1:2.5)	SAR	ESP	O.M (%)
Control	45.3^{e}	24.3^{e}	8.58^{a}	13.8^{a}	16.10^{a}	1.20^{c}
Cyanobacteria	45.8^{e}	26.5^{d}	8.51^{b}	10.6^{b}	12.60^{b}	2.36^{a}
4 ton G.	50.1^{d}	31.1^{c}	8.49^{b}	10.2^{b}	12.10c	1.60^{c}
8 ton G.	63.4^{a}	42.3^{a}	8.41^{c}	8.2^{c}	9.73^{d}	1.30^{c}
Cyano+4 ton G.	53.5^{c}	29.8^{c}	8.47^{c}	8.5^{c}	10.17^{d}	1.81^{b}
Cyano+8 ton G.	57.9^{b}	35.5^{b}	8.45^{c}	8.4^{c}	10.00^{e}	1.95^{b}

Means followed by the same letters were not statistical significantly differed according to Duncan's multiple range test
*S.P =Saturation Percent
**S.F= Structure Factor

The current data suggest that the gypsum treatments were more effective than cyanobacteria treatment (especially 8 ton fed.$^{-1}$) in reducing, sodium absorption ratio (SAR) and exchangeable sodium percentage (ESP), but augmenting saturation percent and structure factor, caused by Ca replacement and leaching of sodium. The present results coincide with those reported by **Abdel Fattah, (2012) .** On the other hand, inoculated cyanobacteria was the least affected treatment on their properties, due to growth of indigenous cyanobacteria was initially slow in alkali soil, due to the high pH and exchangeable Na, **Rao and Burns (1991)**. With regard to organic matter (OM), results showed that applied Cyanobacteria alone or with gypsum treatments increased significantly the OM compared to the control treatment. This is because cyanobacteria play an important role in maintenance and building up the soil fertility

2. Garlic growth parameters:

To evaluate the effects of cyanobacteria and gypsum on garlic (Balady cv.) production under alkaloid soil condition, different rates of them were applied. These previous amendments may be having a role in enhancing growing plants to overcome the problems resulting from soil salinity and its alkalinity.

Vegetative growth characteristics:

Results in **Table (3)** indicated to the effect of cyanobacteria and deferent gypsum levels on leaves number, plant height and dry weight of garlic during seasons of 2015/2016 and 2016/2017.

Table 3: Effect of gypsum levels and cyanobacteria on leaves number, plant height and plant dry weight of garlic.

Treatments	Leaves number		Plant height (cm)		Dry weight (g)	
	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17
Control	9.33^{d}	9.83^{d}	44.68^{e}	46.33^{e}	13.08^{d}	13.34^{e}
Cyanobacteria	10.00^{cd}	10.00^{cd}	49.25^{d}	49.97^{d}	14.21^{d}	14.71^{d}
4 ton G.	10.66^{bc}	10.30b^{cd}	52.33^{c}	53.43^{c}	15.25^{c}	15.53^{c}
8 ton G.	11.00^{ab}	11.22^{ab}	55.80^{b}	56.77^{b}	18.31^{b}	18.44^{b}
Cyano+4 ton G.	10.66^{bc}	10.96^{abc}	54.50^{b}	55.33^{b}	18.07^{b}	18.36^{b}
Cyano+8 ton G.	11.67^{a}	11.33^{a}	57.50^{a}	58.83^{a}	19.82^{a}	20.18^{a}

Means followed by the same letters were not significantly differed according to Duncan's multiple range test.

The existing data indicated that the gypsum treatments (especially 8 ton fed^{-1}) were more effective than cyanobacteria treatment in all previous traits. The results showed that usage cyanobacteria with 8 ton fed^{-1} of gypsum exhibited highest values of leaves number (11.67& 11.33) and plant height (57.50 &58.83) as well as plant dry weight (19.82 & 20.18) compared with the other application and control treatments in the two seasons respectively. These findings are consistent with those of **Muhammad and Khattak (2011),** who acquaint that gypsum increases plant height, grain yield and biomass of most crops. These results may be due to improved root growing conditions and subsequently gypsum may have direct by adding Ca^{++} ion as essential macronutrient, decreasing the negative effect of sodium and chloride and indirect positive effects on crop yields by improving soil characteristics (**Toma *et al.*, 1999 and Ritchey and Snuffer, 2002**). And also may be attributed to cyanobacteria species which are beneficial organisms for soil fertility by fixing atmospheric nitrogen (N), binding soil particles, helping to maintain moisture erosion and producing some growth regulators (**Shariatmadar *et al*, 2013)**.

Yield and its components:

Amended soil with cyanobacteria and gypsum witch give the changes of some traits such bulb diameter, bulb weight, clove weight and total yield of garlic during seasons of 2015/2016 and 2016/2017, **Table (4).**

Table (4): Effect of gypsum levels and cyanobacteria on total yield and its component of garlic.

Treatments	Bulb diameter (cm)		bulb weight (g)		average Clove weight (g)		Total yield (ton/fed)	
	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17
Control	3.74^{d}	3.92^{c}	33.02^{c}	36.05^{c}	17.62^{e}	18.19^{d}	3.64^{e}	3.72^{e}
Cyanobacteria	3.86^{cd}	3.98^{c}	36.02^{c}	38.37^{c}	18.04^{d}	18.99^{cd}	4.09^{d}	4.77^{d}
4 ton G.	4.27^{c}	4.40^{bc}	43.21^{c}	43.47^{bc}	18.84^{d}	20.33^{bc}	4.45^{cd}	4.03^{cd}
8 ton G.	4.90^{b}	5.23^{b}	52.55^{b}	56.15^{b}	21.32^{b}	21.54^{b}	5.61^{b}	5.90^{b}
Cyano+4 ton G.	4.53^{b}	4.67^{b}	50.87^{b}	54.82^{b}	20.06^{c}	21.19^{b}	4.97^{bc}	5.61^{b}
Cyano+8 ton G.	5.60^{a}	5.83^{a}	63.74^{a}	72.56^{a}	23.08^{a}	23.61^{a}	6.75^{a}	6.86^{a}

Means followed by the same letters were not significantly differed according to Duncan's multiple range test

Results revealed that application of cyanobacteria and gypsum at the rate 8 ton fed^{-1} were produced the highest values of previous characteristics compared with the other applications and control followed by 8 ton fed^{-1} gypsum alone then cyanobacteria with 4 ton gypsum treatment in the 1st and 2nd seasons. The increases percent of bulb diameter, bulb weight, average of clove weight and total yield were 49, 97, 30 and 84.9% over the control as average for two seasons. Meanwhile the lowest values of all the above mentioned traits were obtained from the control (without gypsum or cyanobacteria).

These results might be due to the increases in leaves number and plant height as well as root system of the plants **(Kamenetsky *et al*., 2004).** Overall the higher and better above ground growth characters noticed may be attributed to enhanced photosynthetic activity which could have been the result of increased chlorophyll synthesis in presence of desired amount of gypsum and effect of cyanobacteria to improve soil condition. This increase in crop growth due to the integrated effect of gypsum and Bio amendments (cyanobacteria) could be associated with displacement of exchangeable Na from solid phase, improvement in soil physical and chemical conditions, which resulted in enhanced plant growth and yield. **(Choudhary *et. al*., 2004)**. These results are in the same line with those obtained by **Dickson *et al*,.(1990)** and **Mohamedin *et al*., (2012).**

Chemical composition :

Chemical composition of garlic as shown in **Table (5& 6).** The data showed that N, P, K and total carbohydrate % were high significantly increased with increasing the application rate of gypsum with cyanobacteria **(Table 5).**

Table 5: Effect of gypsum levels and cyanobacteria on N, P, K and total carbohydrate % of garlic during two seasons.

Treatments	N %		P %		K %		Total carbohydrates %	
	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17
Control	1.853^{d}	1.833^{d}	0.30^{d}	0.323^{e}	1.133^{d}	1.150^{e}	34.52^{d}	35.97^{d}
Cyanobacteria	2.35c^{c}	2.373^{c}	0.347^{cd}	0.37^{d}	1.197^{c}	1.210^{d}	35.82^{d}	36.59^{d}
4 ton G.	2.570^{b}	2.580^{b}	0.413^{c}	0.417^{c}	1.363^{b}	1.380^{c}	39.55^{c}	40.55^{c}
8 ton G.	2.677^{ab}	2.700^{ab}	0.513^{b}	0.527^{b}	1.420^{b}	1.453^{b}	43.85^{ab}	46.09^{ab}
Cyano+4 ton G.	2.617^{ab}	2.627^{ab}	0.497^{b}	0.507^{b}	1.393^{b}	1.400^{bc}	41.97^{b}	45.07^{b}
Cyano+8 ton G.	2.770^{a}	2.757^{a}	0.633^{a}	0.65^{a}	1.593^{a}	1.613^{a}	44.76^{a}	47.18^{a}

Means followed by the same letters were not significantly differed according to Duncan's multiple range test

Data in **Table 6** showed that effect of different levels of gypsum and cyanobacteria on N, P and K uptake as well as protein % during the two seasons.

Table 6: Effect of gypsum levels and cyanobacteria on N, P and K uptake as well as total protein of garlic during two seasons.

Treatments	N uptake		P uptake		K uptake		Total protein %	
	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17	2015/16	2016/17
Control	23.9^{e}	24.691^{e}	3.92^{d}	4.31^{e}	14.825^{e}	15.339^{e}	10.45^{d}	10.56^{d}
Cyanobacteria	33.722^{d}	34.573^{d}	4.88^{cd}	5.45^{d}	17.016^{d}	17.791^{d}	13.53^{c}	13.93^{c}
4 ton G.	39.324^{c}	39.929^{c}	6.29^{c}	6.47^{c}	20.794^{c}	21.430^{c}	14.71^{b}	14.65^{b}
8 ton G.	49.437^{b}	49.351^{b}	9.37^{b}	9.71^{b}	26.002^{b}	26.797^{b}	15.39^{ab}	15.26^{ab}
Cyano+4 ton G.	47.480^{b}	48.052^{b}	8.89^{b}	9.29^{b}	25.181^{b}	25.709^{b}	14.97^{ab}	14.92^{ab}
Cyano+8 ton G.	54.650^{a}	55.902^{a}	12.56^{a}	13.12^{a}	31.598^{a}	32.540^{a}	15.71^{a}	15.79^{a}

Means followed by the same letters were not significantly differed according to Duncan's multiple range test

The results showed that gypsum treatments and cyanobacteria significantly increased all traits compared to the control treatment for the two seasons. The highest values were obtained from plant treated with cyanobacteria with 8 ton gypsum fed^{-1} in the 1st and 2nd seasons. The increases percent of N, P and K uptake as well as total protein were 127.33, 212.4, 112.63 and 49.76 % as average for two seasons compared to the control (without any addition).

These results may be attributed to gypsum improved the soil conditions to be more suitable for growing of roots with increasing quality hence increasing yield and elements uptake. Also gypsum helps plants absorb plant nutrients, calcium which is supplied in gypsum, is essential to the biochemical mechanisms which most plant nutrients are absorbed by roots. Without adequate calcium, uptake mechanisms would fail. (**Epstein, 1961** and **Neeteson, 1995). Bailey, (1992)** reported that plant uptake of $NH4^{+}$ and $NO3^{-}$ can be improved by increasing the concentration of Ca^{2+} in the root environment, which may explain our findings of increased N content.

Cyanobacteria were found to produce and release bioactive extracellular substances that may influence plant growth and development. These have been reported to be plant growth regulators, vitamins, amino acids, polypeptides, antibacterial or antifungal, substances that exert phytopathogenic biocontrol and polymers, especially exopolysaccharides that improve soil structure and exoenzyme activity (**Abdel-Raouf *et.al.*, 2012).**

Conclusion:

In conclusion from this study it could be concluded that, the combined application of cyanobacteria with 8 ton. fed^{-1} of gypsum could be used to improve the salt-affected soils in North Delta. Also could be adequate source for increasing garlic growth, yield and its components as well as nutrients uptake.

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تحسين نمو وإنتاج الثوم بواسطه الجبس والطحالب الخضراء المزرقه تحت ظروف التربة القلوية

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** معهد بحوث المياه و الاراضى و البيئه- مركز البحوث الزراعية- الجيزة

اجريت هذه الدراسه فى المزرعه البحثيه التابعه لمحطه بحوث البساتين بسخا- محافظه كفر الشيخ شمال الدلتا خلال موسمين 2016/2015 ، 2017/2016. يهدف البحث لدراسه تاثير اضافه الجبس الزراعى (بمعدل 0، 4، 8 طن للفدان) و الطحالب الخضراء المزرقه (السيانوبكتريا) على النموا الخضرى و المحصول ومكوناته و كذلك بعض الخصائص الكيمائيه لمحصول الثوم و مقارنته بالكنترول (البناتات غير المعامله باى من الجبس او الطحالب الخضراء المزرقه).كذلك تاثير ذلك على بعض الخصائص الكيمائيه و الفزيائيه للتربه. واجريت التجربه فى قطاعات كامله العشوائيه اوضحت النتائج ان افضل معامله هى اضافه الجبس بمعدل 8 طن للفدان مع التلقيح بالطحالب الخضراء المزرقه و التى اعطت اعلى قيم لصفات طول النبات و عدد الاوراق و وزن الراس و وزن الفصوص و المحصول الكلى للفدان بالطن و اعلى تركيز لكل من ال N P K وكذلك اعلى امتصاص لتلك العناصر الثلاثه بالمقارنه مع باقى المعاملات وكذلك الكنترول كذلك حسنت من خصائص التربه محل الدراسه حيث اعطت اعلى معامل تربه و اعلى نسبه ماده عضويه و اقل صوديوم متبادل و اقل صوديوم قد امتص.