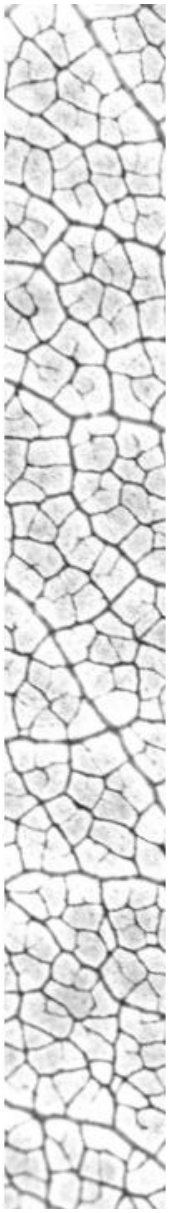

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Improve the vegetative growth and mineral content of grapefruit seedlings by adding some bio and organic fertilizers

Ayad H. E. Alalaf [1*], Ayad T. Shayal Alalam [2], Waleed M.E. Fekry [2]

[1] Department of Horticulture & Landscape Design, College of Agriculture and Forestry, Mosul University, IRAQ
[2] Department of Plant Production, Arid Lands Cultivation Research Institute, City of Scientific Research and Technological Application, Alexandria, EGYPT
*Corresponding author: ayad_alalaf@uomosul.edu.iq

Abstract
The expansion of the use of safe alternatives such as bio-fertilizers and organic fertilizer programs in fruit seedlings has become part of a system known as clean cultivation because of its many advantages that contribute to improving growth, productivity, quality and production of a safe crop as well as preserving the environment by reducing or avoiding the use of chemical fertilizers, Therefore, this study was conducted to demonstrate the importance of adding biological fertilizer (Gorabac G) in three concentrations (5, 10 and 15 grams. Seedlings-1), liquid organic fertilizer (Compo) in three concentrations (4, 6 and 8 ml-1) and organic fertilizer (Rice residues (in three concentrations (0.5, 1.0 and 1.5 kg. Seedlings-1) in addition to the comparison treatment (without adding any type of fertilizer) in improving the vegetative growth and mineral content of grapefruit seedlings grafted on Sour orange, he biological fertilizer (Gorabac G) used in the study and in particular the concentration was 15 grams. Seedlings-1 had a significant effect in obtaining the highest values for most of the studied traits, as this treatment was significantly superior to the comparison treatment with the traits (leaf content of nitrogen, phosphorus, potassium, iron, chlorophyll, carbohydrates and proteins in addition to the increase in the height and diameter of seedlings), so within similar circumstances the study recommends using This concentration of this vital fertilizer is to get strong, well-growing seedlings.

Keywords: grapefruit, seedlings, bio, organic, fertilizers, NPK

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INTRODUCTION

Grapefruit (*Citrus paradise*) is one of the citrus fruits belonging to the genus Citrus, and it may be the result of a genetic mutation from Pomelo or as a result of the genetic hybridization between Pomelo and oranges. The fruits are large in size, spherical in shape, and yellow in ripeness. They contain bitter nerangine, which gives them a distinct bitter taste (Al-Banna and Hijazi, 2010). Fertilization with its various chemical, organic and biological types is among the most important agricultural processes that take place on grafted citrus seedlings, including grapefruit seedlings to improve the nutritional status of the seedlings, which reflects positively on their vegetative growth and their mineral elements content (Alalaf, 2019), and due to the increased costs of chemical fertilizers, especially nitrogenous ones And what it causes pollution to the soil, the environment, and harm to human health when excessive in its use, natural alternatives have been searched recently to reduce the use of these fertilizers, and among these proposed alternatives is the use of biological and organic fertilizers within the concept of clean agriculture (Alalaf, 2020, Ka et al., 2019 and Danmaigoro et al., 2019).

Biofertilizers are one of the important pillars in sustainable agriculture to organize production, protect the environment and produce crops free of pollutants, as they are considered environmentally friendly fertilizers that contain microorganisms capable of supplying plants with the necessary nutrients for them from natural sources through their contribution Effective in providing ready-made nutrients in the cultivated soil, such as nitrogen that is fixed by bacteria and phosphorous prepared by the mycorrhizal fungi so that the roots of seedlings can absorb and benefit from them (Mahdi et al. 2010 and Agarwal et al., 2018), In addition to providing some plant growth organizations that have a role in improving plant growth, such as oxins, gibberellins and cytokines (Sood et al., 2018 and Kumar

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and Kumar, 2019), it also works to increase the organic matter in the soil, which leads to improving its physical, chemical and biological properties, especially in the affected lands. From lack of organic matter (Yadav and Sarkar, 2019 and Bhat et al., 2019).

At the same time, the use of organic fertilizers, including (both liquid and fermented), to reduce environmental pollution, as well as their ability to improve the physical, chemical, biological and fertility properties of the soil because it contains important nutrients in the growth of fruit seedlings (Hassan et al., 2010) increased, as the liquid organic fertilizers It is considered one of the most important clean alternatives because it contains some organic acids such as fulvic and humic acids and amino acids and other materials that are characterized by ease of use and low pollution to the environment and agricultural products and cheap and cheap and their contribution to improving the physical, chemical and biological characteristics of the soil (Alwan and Al-Hamdani, 2012) which is reflected positively in The growth of fruit seedlings, including citrus fruits, In addition, the addition of these fertilizers to fruit seedlings increases the plant's ability to absorb nutrients such as nitrogen, phosphorous, potassium, iron, magnesium, copper, zinc, etc., which results in an increase in the growth of the shoot and root system of the plant (AlcaAntara et al., 2016), in addition to the fact that these materials are easily transferred. And quickly when absorbed by the roots of the plant to benefit from it in the course of physiological processes, especially when subjected to salt stress or drought (Khaled and Fawy, 2011.

There are also many organic fertilizers that are added to the soil, the most important of which are animal wastes, sewage waste, factory waste, poultry and fish residues, as well as industrial organic fertilizers (Compost), which are fertilizers made from crop residues such as rice, straw, corn, palm, gardens, weeds, animal wastes and others (Al-Shibiny, 2005 and Adiaha, 2017), (Al-Abbasi and Al-Zuhairi, 2018) indicated that adding plant residues to fruit plants led to an increase in their processing of their requirements of macro and micro nutrients throughout the growing season, which had a positive effect on the vegetative growth characteristics of the plant, as well as lowering the soil PH. It leads to an increase in the readiness of the nutrients in the soil, in addition to improving the physical properties of them, which will positively affect the growth and development of the root system of the plant. Hao et al. (2008) also concluded that adding organic waste to the soil increases the organic matter in it and increases the number and activity of microorganisms. Such as beneficial bacteria and fungi, which is a good source for preparing plants with nutrients.

Purpose of the study: This study aims to improve the vegetative growth and mineral content of grafted grapefruit seedlings and obtain strong-growth seedlings for the purpose of cultivating them in orchards to early entry into the fruiting stage, with the possibility of substituting chemical fertilizers, even partially, with biological or organic fertilizers to reduce production costs and reduce food and environmental pollution.

Table 1. Some physical and chemical properties of field soils

character	measruing unit	the value
Electrical conductivity	Deci Siemens M^{-1}	0.595
pH		7.50
Organic matter	$G.kg^{-1}$	9.50
$CaCO_3$	$G.kg^{-1}$	175.00
Bicarbonate	$G.kg^{-1}$	0.195
Sand	$G.kg^{-1}$	247.40
Clay	$G.kg^{-1}$	211.60
Silt	$G.kg^{-1}$	541.00
The tissue		Alluvial mixture
Total nitrogen	٪	0.0105
Ready phosphorous	$Mg\text{-}kg^{-1}$	16.92
Ready potassium	Mg-kg	133.39

Soil analyzed in the central laboratory / College of Agriculture and Forestry / University of Mosul

MATERIALS AND METHODS

This study was conducted during the 2020 growing season in the lath house at Horticulture and Landscape Department, College of Agriculture and Forestry, University of Mosul, grapefruit seedlings grafted onto Sour orange seed were selected at the age of two years and nearly equal strength (height 50-60 cm and diameter of the main stem in the grafting area 6.00 - 8.00 mm) and planted in 10 kg polyethylene plastic bags of mixed soil, some of their physical and chemical characteristics are shown in **Table 1**.

Three types of fertilizers were used in the study:

1- Bio Fertilizer (Gorabac G) in three concentrations (5, 10 and 15 g. Seedlings-1), which is a bacterial bio-fertilizer that contains bacteria (Azotopacter chroococcum nitrogen fixing, Bacillus megaterıum fixing potassium and Pseudomonas putida which contributes to increasing phosphorous readiness) and fertilizer production A Hungarian company, fertilizer was added with two dates (4/5 and 5/5). The soil was pollinated with concentrations of biofertilizers in the form of a powder loaded with the food medium (pitmos) by adding the used concentrations and mixing it with a quantity of wet soil. Then a hole was made around the main stem inside Each pond around the seedlings and at a distance of 10 cm from the main stem, 20 cm deep close to the roots, then covered with soil and watered the seedlings immediately after that.

2- Liquid organic fertilizer (Compo) in three concentrations (4, 6 and 8 ml. Liters-1) contains 52% organic matter, 3% organic nitrogen and 6% potassium in the form of K2O, the fertilizer was added in the form of the first two batches on (5/4) And the second on (5/5), 4 ml was dissolved in 1 liter of distilled water to prepare a concentration of 4 ml-1 liter, then this concentration

Table 2. The effect of adding biofertilizers (Gorabac G) and organic fertilizers (Compo and rice residues) on nitrogen, phosphorous and potassium content and iron and zinc content in grapefruit seedlings

Treatments	Concentrations	Studied traits				
		N %	P %	K %	Fe ppm	Zn ppm
Control	Zero	**1/42** C	C 0.147	B 0.95	B 67.23	A 27.62
Organic fertilizers rice residues K. transplant^{-1}	**0/5**	A 1.87-C	BC 0.167	B 1.01	AB 74.74	A 27.16
	1/0	A 1.93-C	BC 0.162	B 1.19	AB 76.44	A 27.43
	1/5	A 1.90-C	A 0.174-C	B 1.20	AB 74.81	A 24.84
Organic fertilizers Compo ML . l^{-1}	**4**	A 1.94-C	A 0.208-C	B 1.17	AB 75.81	A 26.48
	6	BC 1.82	A 0.182-C	B 1.25	A 82.50	A 27.95
	8	A 1.85-C	A 0.206-C	B 1.33	AB 79.70	A 27.05
Biofertilizers Gorabac G g.transplant^{-1}	**5**	AB 2.00	A 0.197-C	B 1.36	A 82.56	A 29.56
	10	A 1.89-C	AB 0.226	B 1.35	AB 80.63	A 28.25
	15	A 2.38	A 0.250	A 1.78	A 82.00	A 28.20

* The mean of the coefficients of interference followed by different letters indicate that there are significant differences between them at the 5% probability level according to the Dunkin Polynomial test.

was divided by the number of seedlings in one treatment (3 seedlings), so that each seedling got about 300 The same applies to the two concentrations 6 and 8 ml-1 (the fertilizer produced by a German company).

4-Organic fertilizer (rice residues) in three concentrations (0.5, 1.0 and 1.5 kg. Seedlings-1), mixing the dissolved fertilizer with sand on 5/4, which was presented in the center for the production of organic fertilizers from agricultural waste / Najaf / Iraq in plastic bags of capacity 10 kg, once a season.

4-Comparison treatment (without adding any type of fertilizer).

The implementation of the study followed the design of the complete randomized sectors of global experiments (R.C.B.D) in a simple experiment with three replicates and three seedlings per experimental unit, so that the number of seedlings used in the study is 90 seedlings, at the beginning of the month of August during the growing season the following characteristics were measured:

1-leaves content of chlorophyll (SPAD unit) Soil Plant Analysis Design, using SPAD digital meter - 502meter (Felixloh & Bassuk, 2000):

2- The concentrations of nutrients in leaves (nitrogen% using the Microkjeldahl device described by (Bhargava and Raghupathi, 1999), phosphorous% by a Spectrophotometer, and potassium% according to the method suggested by Horneck and Hanson (1998), and iron and zinc (mg. Liter-1) by using the Atomic Absorption Spectro photometer.

3-Leaf carbohydrate content (%): The total carbohydrate content of leaves was estimated using the Joslyn (1970) method.

4- The percentage of protein in the leaves according to the following equation: The percentage of protein% = the percentage of nitrogen x 6.25 (A.O.A.C, 1970).

At the end of the growing season, the increase in the height of the seedlings (cm) was measured from the surface of the bag's soil to the top of the stem and (the increase in the diameter of the main stem of the seedlings (mm) by the foot at a height of 10 cm from the surface of the bag's soil by measuring both the seedling height and the diameter The chair presented it before conducting the experiment and at the end of the experiment and recorded the difference between the two readings, the results were statistically analyzed according to the design used using the computer according to the SAS program (SAS / STAT, 2001) and the averages were compared using the Dunkin polynomial test at the 0.05 error probability level.

RESULTS AND DISCUSSION

The results shown in **Table 2** indicate that the addition of organic fertilizer concentrations) Gorabac G (had a significant effect on the concentration of nutrients (NPK) in the seedling leaves, especially the concentration of 15 g.transplant-1, which gave the highest significant values of these elements, reaching (2.38% 0.250% and 1.78%), respectively, compared to the comparison treatment (non-fertilized seedlings) which gave the lowest values for these elements, respectively (1.42%, 0.147% and 0.95%). As for the characteristic of the iron content of leaves, it appeared that the treatment of adding biological fertilizer) Gorabac G (with a concentration of 5 g.transplant-1 gave its highest significant value of 82.56 (PPM), followed by the treatment of adding organic fertilizer)Compo(with a concentration of 6 ml.l-1, which reached (82.56 PPM), then the treatment of adding the organic fertilizer) Gorabac G (at a concentration of 10 g. transplant-1 and reached (82.00 PPM). These parameters significantly exceeded the comparison treatment, which recorded the lowest value for this characteristic and reached (67.23 PPM), while the results of the same table showed that there were no significant differences in all fertilizer treatments used in the study, including the comparison treatment as the content of leaves Of the element zinc, knowing that the highest value was (29.56 PPM) as a result of the addition of 5 g.transplant-1 bio-fertilizer) Gorabac G).

The significant superiority of the addition of biological fertilizer concentrations (Gorabac G), especially the concentration (15g. Transplant-1), may explain the increase in seedlings leaf content of mineral elements (nitrogen, phosphorus, potassium and iron) as a result of this fertilizer containing bacteria (Azotopacter

Table 3. The effect of adding biofertilzers (Gorabac G) and organic fertilizers (Compo and rice residues) on the increase in the height and diameter of seedlings and the leaf content of chlorophyll, Carbohydrates and protein for grapefruit seedlings

Treatments	Concentrations	Studied traits				
		The increase in the height of seedlings	The increase in the diameter of seedlings	The leaf content of chlorophyll	The leaf content of Carbohydrates	The leaf content of protein
Control	zero	B 12.93	D 1.20	E 71.00	D 19.28	C 8.89
Organic fertilizers rice residues K. transplant^{-1}	0.5	A 27.21	C 1.91	CD 93.53	C 23.06	A 11.72-C
	1.0	A 28.30	C 1.75	DE 85.47	BC 24.47	A 12.06-C
	1.5	A 30.07	A 2.26-C	DE 85.53	BC 24.87	A 11.87-C
Organic fertilizers Compo ML . l^{-1}	4	A 30.59	B C 2.16	AB 111.12	AB 28.60	A 12.12-C
	6	A 30.62	A 2.31-C	A 107.98-C	**A 30.08**	BC 11.41
	8	A 29.85	A 2.31-C	AB 112.78	AB 27.17	A 11.56-C
Biofertilizers Gorabac G g.transplant^{-1}	5	A 30.63	AB 2.75	B-D 99.60	AB 27.34	AB 12.54
	10	A 33.43	**A 2.83**	A 103.99-C	**A 31.30**	A 11.83-C
	15	**A 34.15**	**A 2.82**	**A 116.07**	**A 30.48**	**A 14.89**

*The mean of the coefficients of interference followed by different letters indicate that there are significant differences between them at the 5% probability level according to the Dunkin Polynomial test

chroococcum, Bacillus megaterıum and Pseudomonas putida)), As the bacteria Azotopacter chroococcum works to stabilize atmospheric nitrogen by converting gaseous nitrogen N2 into ammonia or by converting nitrogen from the form of ammonia to nitrate, while Bacillus megaterıum bacteria have the ability to convert potassium from the insoluble form into a soluble form ready for absorption by the plant. While Pseudomonas putida bacteria dissolves insoluble and non-absorbable phosphorous into an absorbable and dissolved form in the soil, and through the role of these types of bacteria in increasing the readiness of nutrients in the soil, their absorption by the roots and their transfer within the plant increases, so the leaves content of these elements increases. Also, these bacterial species have a great role in secreting some plant growth regulators and thus developing the growth of the group Atomic and then increased absorption of nutrients and their transfer to the shoots, to accumulate in the leaves and increase in concentration (Alalaf and Hdeed, 2020 A and Akram et al., 2020).

It is evident from the results of **Table 3** that all fertilizer treatments used in the study had a significant effect as the increase in seedlings height compared to the comparison treatment (non-fertilized seedlings), and the highest significant value for this characteristic was (34.15 cm) as a result of adding the organic fertilizer) Gorabac G (at a concentration (15g.transplant-1), as measured by the lowest value for this characteristic, which was (12.93 cm) for the comparison treatment, and it is also noticed that the same treatment of biological fertilizer gave the highest values for the two traits (leaf content of chlorophyll and relative protein content in leaves), which were respectively (116.07 SPAD and 14.89%). They significantly outperformed a number of transactions, especially the comparison treatment, which recorded the lowest values for them at (71.00 SPAD and 8.89%), respectively. It was also found that the addition of biological fertilizer with both concentrations (10 and 15 g.transplant-1) significantly outperformed a number of treatments, especially the comparison treatment as (the increase in seedling diameter and the leaf content of carbohydrates) and that the highest significant values of these two characteristics were respectively (2.83 Mm and 31.30%).

These results can be explained by the moral superiority of adding the concentrations of the biological fertilizer (Gorabac G) with the characteristics (the increase in the height and diameter of the seedlings and the content of the leaves of carbohydrates, chlorophyll and proteins) as a result of the role of this fertilizer in improving growth by providing the necessary nutrients, especially the major elements (nitrogen, potassium and phosphorous) in a manner. Ready in the soil and increase its concentration in the leaves (**Table 2**) so that the roots of the seedlings can absorb them, benefit from them and transfer them to the rest of the plant parts, especially the leaves, in order to effectively contribute to many physiological processes in the plant such as photosynthesis and the manufacture of carbohydrates and proteins, and thus all of this is positively reflected on the growth characteristics. Vegetative and leaf content of carbohydrates and proteins (Sharma et al., 2019), and as a result of their containing a number of bacteria that secrete a number of growth hormones (such as gibberellins, cytokinins and oxins) which improve plant growth as a result of their role in cell division and elongation as well as their importance in increasing The ability of plants to absorb water and nutrients by improving the growth efficiency of the c system This is reflected positively in improving the vegetative growth characteristics of seedlings (Alalaf and Hadeed, 2020 b), as well as the role of biological fertilizers in reducing the degree of soil reaction (pH), which leads to an increase in the readiness of the micro-elements needed by the plant, especially (iron and zinc), and their accumulation increases in leaves (Singh et al. 2106).

CONCLUSION

The results of the study showed that grapefruit seedlings responded significantly to the addition of the

added concentrations of (Gorabac G), especially the concentration of 15 grams. Seedlings-1 as seedlings have improved growth and their content of mineral elements, so the study recommends the necessity of using this fertilizer with the possibility of using other types of biological and organic fertilizers to reduce the use of chemical fertilizers and reduce their bad effect.

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REFERENCES

A.O.A.C. (Association of Analytical Chemists). (1970). Officials Methods of Analysis 11th ed. Washington. D. C. p.1015.

Adiaha M S (2017). The Role of Organic Matter in Tropical Soil Productivity. World Scientific News 86(1) : 1-66.

Agarwal P, Gupta R and Gill I K (2018). Importance of biofertilizers in agriculture biotechnology. Annals of Biological Research, 9 (3): 1-3.

Akram M S, Cheema M A, Waqas M, Bilal M, Saeed M (2020).Role of Bio-Fertilizers in Sustainable Agriculture. gricultural sciences & agronomy > doi: 10.20944/ preprints202003. 100262

Al-Abbasi G B, and Al-Zuhairi F F (2018). The role of biological and organic fertilization in the concentration of N, P, K in the leaves of Pomelo seedlings Citrus grandis L. grafted on different origins and the readiness of N, P in the soil. Karbala Journal of Agricultural Sciences. (4) 4: 69—84.

Alalaf A H (2019). Effect of budding date and Chemical, Organic and bio fertilization on budding success of local orange and subsequent growth of the seedlings. Ph.D. Thesis. Hort. & Landscape Design Dept. College of Agric. & Forestry, Mosul University, Iraq.

Alalaf A H (2020). The role of biofertilization in improving fruit productivity : a review. Int. J. Agricult. Stat. Sci. Vol. 16, No. 1, pp. 107-112.

Alalaf A H and Hadeed N N (2020 A). Effect of Chemical, Organic and Bio-fertilizers on the Availability of some Nutrients in Grafted Orange Seedlings. Middle East Journal of Agriculture Research, Volume : 09 | Issue : 02 : 411-419.

Alalaf A H and Hadeed N N (2020 B). Response of Local Orange Grafted to the Date of Grafting, Chemical, Organic and Bio-fertilizers. East Journal of Agriculture Research, Volume : 09 | Issue : 02 : 444-454.

Al-Banna G and Hijazi A (2010). Evergreen fruit. Translated book. William Henry Chandler. Arab House for Publishing and Distribution. The Egyptian Arabic Republic.

AlcaAntara B, Mary R, Almudena B and Francisco L (2016). Liquid Organic Fertilizers for Sustainable Agriculture: Nutrient Uptake of Organic versus Mineral Fertilizers in Citrus Trees. PLoS ONE 11(10): 0161619. doi:10.1371/journal.

Al-Shibiny J M (2005). Fertilization programs for fruit gardens. Egyptian Library for Publishing and Distribution. Alexandria. The Egyptian Arabic Republic. Number of pages 318.

Alwan J M and Al-Hamdani I A (2012). Organic farming and the environment. Ibn Al Atheer House for Printing and Publishing. University of Al Mosul. Iraq.

Bhargava B S and Raghupathi H B (1999). Analysis of Plant Materials for Macro and Micronutrients. (49-82). In Tandon, H.L.S. (eds). Methods of Analysis of Soils, Plants, Water and Fertilizers. Binng Printers L- 14, Lajpat Nagor New Delhi,110024.

Bhat N A, Rasool R and Ramzan S (2019). Plant Growth Promoting Rhizobacteria (PGPR) for Sustainable and Eco-Friendly Agriculture. Acta Scientific Agriculture 3)1): 23-25.

Danmaigoro, O., A.G, Halilu. A.U, Izge. (2019). Growth and yield of direct seeded upland rice varieties as influenced by weed management and organic manure application. Journal of Research in Weed Science, 2(2), 103-114. doi: 10.26655/jrweedsci.2019.3.2

Felixloh J G and Bassuk N (2000).Use of the Minolta SPAD -502 to determine chlorophyll level in Ficus benjamina L. and populous deltoids Marsh leaf tissue.Horticulture Science.,35(3)P.423.

Hao X H, Liu S L, Wu J S, Hu R G, Tong C L, and Su Y Y (2008). Effect of long - term application of inorganic fertilizer and organic amendments on soil organic matter and microbial biomass in three subtropical paddy soils. Nutr. Cycling in Agroeco system. 81(1): 17- 24.

Hassan H S, Sarrwy S M and Mostafa E A. (2010). Effect of foliar spraing with liquid organic fertilizer, some micronutrients, and gibberellins on leaf mineral content, fruit set, yield and fruit quality of " Hollywood" plum trees.Agricultur.Biology.Journal.North.America.1 (4):638-643.

Horneck D A, and Hanson D (1998). Determination of potassium and sodium by flame emission spectrophotometry. 153-155. In: Kalra, Y. P. (ed.). Handbook of Reference Methods for Plant Analysis. Soil and Plant Analysis Council, Inc. CRC Press. FL. USA. 287.

Joslyn M A (1970). Methods in food Analysis, physical, chemical and instrumental methods of analysis, 2nd ed. Academic press. New York and London.

Ka, S., Gueye, M., Mbaye, M., Kanfany, G., Noba, K. (2019). Response of a weed community to organic and inorganic fertilization in peanut crop under Savannah zone of Senegal, West Africa. Journal of Research in Weed Science, 2(3), 241-252. doi: 10.26655/jrweedsci.2019.2.3.7.

Khaled H, and Fawy H A (2011). Effect of different levels of humic acids on the nutrient content, plant growth, and soil properties under conditions of salinity. Soil & Water Res., 6 (1): 21–29.

Kumar M and Kumar K (2019). Role of Bio-fertilizers in vegetables production: A review. Journal of Pharmacognosy and Phytochemistry; 8(1): 328-334.

Mahdi S S, Hassan G I, Samoon S A, Rather H A, Dar S A and Zehra B (2010). Bio-fertilizers in organic agriculture. Journal of Phytology, 2(10): 42-54.

SAS. (2001). SAS/ STAT Users Guide for personal computers, SAS Institute Inc, Cary, N. C. USA.

Sharma K, Sharma S and Prasad S R (2019). PGPR: Renewable Tool for Sustainable Agriculture. International Journal of Current Microbiology and Applied Sciences. 8(1): 525-530.

Singh M, Dotaniya M L, Mishra A, Dotaniya C K, Regar K L and Lata L (2016). Role of biofertilizers in conservation Agriculture. Springer Science.Business Media Singapore.

Sood M K, Kachawaya D S and Singh M C (2018). Effect of Bio fertilizers and Plant Growth Regulators on Growth, Flowering, Fruit Ion Content, Yield and Fruit Quality of Strawberry. International Journal of Agriculture, Environment and Biotechnology : 11(3): 439-449.

Yadav K K, and Sarkar S (2019). Biofertilizers, Impact on Soil Fertility and Crop Productivity under Sustainable Agriculture. Environment and Ecology 37 (1) : 89—93.