EFFECT OF SEED SOAKING AND ORGANIC AND MINERAL FERTILIZERS ON GROWTH AND YIELD OF OKRA *Abelmoschus esclentus* L. UNDER UNHEATED GREENHOUSES

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Article Information

Editor(s):
(1) Dr. Vinayaka K. S., Kumadvathi First Grade College, India.
Reviewers:
(1) Mihaiela Cornea-Cipcigan, University of Agricultural Sciences and Veterinary Medicine, Romania.
(2) Obyedul Kalam Azad, Kangwon National University, Korea.

Received: 29 December 2020
Accepted: 03 March 2021
Published: 20 March 2021

Original Research Article

ABSTRACT

The experiment included 8 treatments which are possible combinations of two seed treatments before planting (without soaking and soaking in water for 12 hours) and three levels of fertilizer (10 tons. Kg -1 organic fertilizer + 500 kg S h -1 agricultural sulfur, 20 tons kg -1 organic fertilizer + 750 Kg S h -1 agricultural sulfur, 30 tons kg -1 organic fertilizer +1000 kg S h -1 agricultural sulfur) in addition to the comparison treatment (without fertilization)

The split-plot design was carried out as a one-time split-plot design according to the Randomized Complete Block Design (R.C.B.D) and with three iterations for each treatment. The arithmetic means of the transactions were compared using the L.S.D test at a 0.05 level of significance. The most important results are summarized as follows:

The results showed significant superiority of seed soaking before planting in vegetative growth characteristics such as plant height, a number of side branches, and chemical characteristics such as leaf content of total chlorophyll and the percentage of nitrogen, phosphorus, and potassium in the leaves, and soaking the seeds before planting resulted in a significant increase in the overall productivity of the plant. An increase of 123.64% compared to not soaking the seeds

The results also showed a significant superiority for adding organic and mineral fertilizers together in all the characteristics of vegetative growth, chemical characteristics, and quantitative yield, especially at the levels 20 tons kg -1 organic fertilizer + 750 kg S h -1 agricultural sulfur and 30 tons kg -1organic fertilizer +1000 kg S h -1 agricultural sulfur.

Keywords: Okra; Unheated Green house; Organic fertilizers; Early yield.

INTRODUCTION

Okra (*Abelmoschus esclentus* L) is an important vegetable and belongs to the Malvaceae family. Okra has a high nutritional value [1], as its fruits contain protein 17.16%, carbohydrates 60.90%, fat 2.07% 93.326% energy, and also contain important elements such as zinc 51 parts per million, iron 371 parts per million, and calcium 107 parts per million [2].

It is grown in various parts of the country. Because of its great economic importance, the fact that its fruits are highly desirable to most of the population of the country, as it is considered one of the important vegetables in Iraq because of its importance to the consumer and has an economic return for the farmer. Therefore, the demand for cultivating it in greenhouses and tunnels increased, especially after the spread and expansion of protected agriculture in Iraq [3] Okra needs a long, warm growing season where the seeds germinate at a temperature ranging from (21 - 35) to sprouted in less than 15 and higher than 40. The germination of its seeds can be accelerated in cold weather by soaking it in water for a period of at least 8 hours. Then compost it in a warm place for at least 24 hours. Before planting them, taking into account not to increase the soaking and composting in order not to lead to damage to the seeds [4].

Many studies have been interested in studying the effects of organic fertilizers on plant growth and yield, as organic matter is one of the important and effective factors in influencing the readiness of plant nutrients due to its properties that affect the soil's nutrient content and make it ready for absorption by the plant and then positively affect growth and development Plant [5,6,7].

Adding organic waste to the soil increases the organic matter in it and increases the number and activity of microorganisms, as well as continuously adding nutrients to the soil, which restores the balance of the nutrients in it. Thus, the added organic matter is a good source for preparing the plant with nutrients, as well as reducing its loss through washing, by adsorption on the surfaces of its microelements [8,9,10].

Organic fertilizers are the main and safe source for providing plants and thus humans with nutrients, in addition to their great role in improving the chemical and physical properties of soil One of the most used is sheep and poultry manure, which contain large proportions of nutrients, and the proportion of both nitrogen and phosphorous in poultry manure is high, while the proportion of potassium is high in livestock manure [11,12,13].

Soils of arid and semi-arid regions, such as Iraqi soils, have a high content of calcium carbonate and have a high pH that tends to be alkaline, and thus the readiness of the nutrients [14], especially the micronutrients, decreases. Therefore, methods must be followed that will increase the readiness of these important elements in increasing the physiological processes. For the plant and thus increase the yield growth, and because the plant cannot complete its life cycle without it, and one of these methods is the addition of agricultural sulfur to the soil, which is involved in many reactions that take place in the soil, and this is due to the multiplicity of chemical, organic and mineral sulfur forms and the multiplicity of types of microorganisms that contribute On its transformations in soil [15,16].

Based on the above and the importance occupied by the okra plant and in view of the positive role of pre-soaking the seeds before planting and the importance of both organic fertilizer and agricultural sulfur and adding them together before planting and the lack of studies on these two factors on okra plant grown under the low plastic tunnels in the southern region of Basra Governorate, this study came to show the effect These two factors affect vegetative growth indicators, chemical characteristics, and quantitative yield of the local okra plant.

MATERIALS AND WORKING METHODS

The study was conducted during the winter agricultural season 2019 in one of the unheated greenhouses with dimensions 10 * 30 affiliated to the Agricultural Research Station at the College of Agriculture / University of Basra, a greenhouse soil was taken before planting by taking random samples from different places with a depth of 0-30

cm. Table (1) shows some of the physical and chemical characteristics of the experiment soil.

The compost (cow waste) was collected and prepared from the fields of the Agricultural Research Station of the College of Agriculture / the University of Basra, then these wastes were placed in concrete ponds 3 x 6 m (length x width) 5 m high, lined with polyethylene to prevent the saline effect, and placed with the waste (initiator Bacterial) 40 kg.

Urea/ha were then moistened until saturation and then covered with plastic for the purpose of encouraging reactions and speeding up the process of decomposition, and the waste has fluctuated every two weeks for the purpose of moisture homogeneity and the incubation process continued for a period of 3 months, Table (2) shows some chemical properties of the organic residues after decomposition.

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The sulfur content of 92 -96% together before planting with (10) days for the experimental units assigned according to the following levels

Control (without any addition) denoted by M0

10 tons. Kg -1 organic fertilizer + 500 kg S h -1 sulfur, symbolized by M1

2tons kg -1 organic fertilizer + 750 kg S h -1 sulfur, symbolized by M2

30 tons kg -1 organic fertilizer +1000 kg S h -1 sulfur, symbolized by M3

The drip irrigation system was used to irrigate the plants, and the planting lines were covered with black plastic. Transactions were distributed randomly to the experimental units. The experiment was carried out with the split-plot design system and with three replications where seed treatments were taken before sowing (without soaking and soaking the seeds for 12 hours). Subplot The seeds were soaked before planting for a period of time. 12 hours, seeds of the local variety of okra plant were planted and prepared under the supervision of Basra Agriculture Directorate on 1/1/2019.

Three seeds were placed in each hole and the seeds were planted on one side of the drip, with a distance of 25 cm between each seed and the other after germination. The agricultural industry used to produce this crop in greenhouses, cover the structure of the greenhouse with transparent white plastic for the winter agricultural season on 1/1/2019 and raise it on 1/4/2019, after which the house is covered with the green canopy (Saran). The start of harvesting the crop 3/20/2019 and the reaping ended on 6/7/2019. The results were analyzed using analysis of variance and the lowest significant difference test (L.S.D) was chosen to compare the averages with equal probability (0.05).

Studied Traits

Plant height (cm), a number of branches, chlorophyll contents in leaves, the nitrogen concentration in leaves(%), potassium concentration in leaves(%), phosphorus concentration in leaves (%), early yield, total yield.

RESULTS AND DISCUSSION

Plant height (cm):

Table (3) showed that the seed treatments had a significant effect on the characteristic of plant height, as the seed soaking treatment had a

significant effect on plant height, with an increase of (20.32)% compared to no soaking

The table also shows that the fertilization treatments had a significant effect on the plant height characteristic, as the M3 treatment had a significant effect on the plant height, with an increase of (25.75)% compared to the comparison treatment.

As for the interference, it was significant, as the seed soaking treatment + M3 fertilization treatment gave the highest plant height of 132.35 cm.

Number of branches(branch Plant^{-1}): Table (4) showed that seed treatments had a significant effect on the characteristic of the number of side branches, as the treatment of seed soaking before planting had a significant effect on the number of side branches, with an increase of (67.29)% compared to after soaking, It is also clear from the table that fertilization treatments had a significant effect on the quality of the number of side branches, as the treatment M3 had a significant effect on the number of side branches, with an increase of (49.53)% compared to the comparison treatment, As for the interaction, it was significant, as the seed soaking treatment + M3 fertilization treatment gave a significant increase in the number of plant branches, which reached 12.48 (plant branch $^{-1}$).

Total chlorophyll in the leaves (ml 100 g soft weight): Table (5) showed that the seed treatments had a significant effect on the leaf content of total chlorophyll, as the treatment of seed soaking before planting had a significant effect on the leaf content of total chlorophyll, with an increase of 31.23% compared to no soaking.

The same table also shows that fertilization treatments had a significant effect on leaf content of total chlorophyll, as treatment M2 had a significant effect on leaf content of total chlorophyll, with an increase of 21.61% compared to the comparison treatment.

Table 1. Some physical and chemical properties of soil and water for the growing season 2019

Type of analysis	the value	unit
EC	**6.11**	ds.m^{-1}
pH	**7.20**	**-**
Total nitrogen	**20.2**	g.kg^{-1}
Ready phosphorous	**0.016**	g.kg^{-1}
Ready Potassium	**1.15**	g.kg^{-1}
Organic matter	**0.55**	**%**
The proportion of clay	**44.53**	**%**
Silt ratio	**43.20**	**%**
Sand ratio	**12.27**	**%**
Humidity at field capacity	**28.13**	**%**
Characteristics of irrigation water		
EC	1.66	ds.m^{-1}
pH	7.23	-

Table 2. Some chemical properties of organic fertilizers

Type of analysis	Before	After fermentation
pH	fermentation	**6**
E.C	6.5	**5**
Organic matter	4.5	**160.31**
	152.32	**10.5**
N Total	6	**11**
P Total	7.83	**4.50**

Table 3. The effect of seed treatments and fertilization levels on plant height (cm) for okra

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**82.24**	**117.46**	**100.35**
M1	**92.98**	**119.91**	**106.94**
M2	**112.61**	**120.99**	**118.54**
M3	**120.02**	**132.35**	**126.19**
Effect rate of seed treatments	**101.96**	**122.68**	
Fertilization levels	Seed treatments	interaction	L.S.D
4.39	**6.82**	**6.40**	(0.05)

Table 4. The effect of seed treatments and fertilization levels on branch number(branch.plant^{-1}) of okra

Fertilization levels	Seed treatments		Impact rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**5.11**	**7.81**	**6.46**
M1	**5.44**	**8.80**	**7.12**
M2	**5.96**	**9.99**	**7.98**
M3	**6.84**	**12.48**	**9.66**
Effect rate of seed treatments	**5.84**	**9.77**	
Fertilization levels	Seed treatments	interaction	L.S.D(0.05)
0.22	**0.17**	**0.28**	

As for the interaction, it was significant, as the seed soaking treatment + the M2 fertilization treatment gave a significant increase in the leaf content of total chlorophyll, reaching 74.70 (mg 100 g soft weight).

Leaves Content of Total Nitrogen(%)

It is evident from Table (6) that the seed treatments had a significant effect on the leaves 'total nitrogen content, as the treatment of soaking the seeds with water significantly outperformed them, with an increase of 38.18% compared to not soaking.

The same table also shows that fertilization treatments had a significant effect on the total chlorophyll content of leaves, as the M2 fertilization treatment had a significant effect and gave an increase of 21.66% compared to the comparison treatment.

Leaf Content of Total Phosphorous(%)

Table 7. showed that the seed treatments had a significant effect on the total phosphorous content of leaves, as it affected the soaking treatment with an increase of 170% compared to non-soaking.

It is also evident from the table that fertilization treatments had a significant effect on leaf content of total phosphorus, as the treatment M3 affected, with an increase of 190.47% compared to the comparison treatment.

As for the interaction, it was significant, as the seed soaking treatment + M3 fertilization treatment gave the highest total phosphorous content of 0.95%.

Leaf content of Total Potassium(%)

Table (7) showed that the seed treatments had a significant effect on the total potassium content of leaves, as it affected the soaking treatment with an increase of 48.57% compared to not soaking.

It is also evident from the table that fertilization treatments had a significant effect on the total potassium content of leaves, as the treatment M3 affected, with an increase of 27.31% compared to the comparison treatment.

As for the interaction, it was significant, as the seed soaking treatment + M3 fertilization treatment gave the highest total potassium content, which reached 3.25%.

Table 5. The effect of seed treatments and fertilization levels on the leaves content of total chlorophyll ml 100gm soft weight

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**46.11**	**63.80**	**54.95**
M1	**48.90**	**67.71**	**58.30**
M2	**57.51**	**74.71**	**66.11**
M3	**57.43**	**69.60**	**63.51**
Effect rate of seed treatments	**52.49**	**68.95**	
Fertilization levels	Seed treatments	interaction	L.S.D(0.05)
8.35	**6.23**	**10.56**	

Table 6. The effect of seed treatments and fertilization levels on the leaves content of total nitrogen (%)

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**3.12**	**4.37**	**3.74**
M1	**3.32**	**4.90**	**4.11**
M2	**3.91**	**5.18**	**4.55**
M3	**3.69**	**4.96**	**4.33**
Effect rate of seed treatments	**3.51**	**4.85**	
Fertilization levels	Seed treatments	interaction	L.S.D
0.24	**0.27**	**0.32**	(0.05)

Table 7. The effect of seed treatments and fertilization levels on the leaves content of total Phosphorus (%)

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**0.11**	**0.30**	**0.21**
M1	**0.17**	**0.38**	**0.27**
M2	**0.22**	**0.51**	**0.37**
M3	**0.27**	**0.95**	**0.61**
Effect rate of seed treatments	**0.19**	**0.54**	
Fertilization levels	Seed treatments	interaction	L.S.D
0.02	**0.09**	**0.07**	(0.05)

Table 8. The effect of seed treatments and fertilization levels on the leaves content of total potassium (%)

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**1.73**	**2.81**	**2.27**
M1	**1.85**	**3.21**	**2.53**
M2	**2.28**	**3.22**	**2.75**
M3	**2.54**	**3.25**	**2.89**
Effect rate of seed treatments	**2.10**	**3.13**	
Fertilization levels	Seed treatments	interaction	L.S.D
0.19	**0.34**	**0.30**	(0.05)

Early Yield (g m^{-2})

Table (9) showed that seed treatments had a significant effect on the early yield of a plant, as the soaking seed treatment before sowing affected the increase in the early yield of a plant, with an increase of 38.88% compared to no soaking.

It is also clear from the table that fertilization treatments had a significant effect on the early

yield of a plant, as the treatment M3 affected, with an increase of 40.86% compared to the comparison treatment.

As for the interaction, it was significant, as the seed soaking treatment + M3 fertilization treatment gave the highest early yield for plants, which reached 158.9 g m^{-2}.

Total Plant Yield (kg m^{-2})

Table (10) showed that seed treatments have a significant effect on total productivity, as it affected the soaking treatment before sowing, with an increase of 123.64% compared to non-soaking.It is also evident from the table that fertilization treatments had a significant effect on total productivity, as the treatment M3 affected, with an increase of 118.18% compared to the comparison treatment.

As for the interaction, it was significant, as the seed soaking treatment + M3 fertilization treatment gave the highest total plant productivity of 1.77 kg m 2.

the results of Tables (10.9,8,7,6,5,4,3) that soaking the seeds before planting had a significant effect on plant height, number of side branches, leaf content of total chlorophyll, nitrogen component, phosphorus, potassium, early and total yield of okra plant and this It is due to the fact that the soaking process led to the speed of seed germination as a result of softening the solid seed coatings and the decomposition of complex sugars into simple ready-to-manufacture proteins and Auxines, the role of Auxines in cell wall ductility and the role of proteins in the production of new tissues [17]**.**

This led to the acceleration of early growth [18] and thus increased plant height, which resulted in an increase in the number of lateral branches and thus an increase in the chemical components and the total yield of the plant, This result is consistent with what [19] found on okra.

the addition of organic fertilizer with agricultural sulfur before planting led to an increase in plant height, number of side branches and leaf content of total chlorophyll, nitrogen, phosphorus, potassium and early yield. And the whole plant of okra as the addition of organic fertilizers improves the physical, chemical and biological properties of the soil, and the organic fertilizers provide a balanced food for the plant as a result of their slow release of the elements and contain many elements that help the plants to grow well and perform the physiological activities of the plant perfectly [20,21] and this is clear The noticeable increase in

Table 9. The effect of seed treatments and fertilization levels on early yield (g m^{-2}) for Okra

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**81.7**	**99.0**	**90.3**
M1	**90.2**	**104.0**	**97.1**
M2	**92.6**	**137.9**	**115.3**
M3	**95.4**	**158.9**	**127.2**
Effect rate of seed treatments	**90.0**	**125.0**	
Fertilization levels	Seed treatments	interaction	L.S.D
7.9	**11.65**	**11.30**	(0.05)

Table 10. The effect of seed treatments and fertilization levels on total yield (kg m^{-2}) for Okra

Fertilization levels	Seed treatments		Effect rate of Fertilization levels
	Without soaking	Soak the seeds	
M0	**0.41**	**0.69**	**0.55**
M1	**0.49**	**1.22**	**0.85**
M2	**0.67**	**1.25**	**0.96**
M3	**0.64**	**1.77**	**1.20**
Effect rate of seed treatments	**0.55**	**1.23**	
Fertilization levels	Seed treatments	interaction	L.S.D(0.05)
0.13	**0.26**	**0.21**	

plant height and the number of side branches, which resulted in an increase in early yield and thus increased overall plant productivity.

The addition of sulfur is one of the means that helps to modify the degree of soil interaction and increase the readiness of nutrients, which will positively affect plant growth [22]

The addition of organic fertilizer with agricultural sulfur together before planting led to an increase in plant height, number of side branches, leaf content of phosphorous and potassium elements, early yield and overall plant productivity, and this is due to the fact that adding organic fertilizers and sulfur to the soil improves its fertility condition and the balance of elements in the soil is good. The nutrients are in a ready state for better absorption and the soil pH tends to be moderate [23]. These factors all work to improve plant growth and thus increase the overall productivity of the plant, and these results are consistent with [24] found on the onion plant.

As for the bilateral overlap between the two factors of the experiment, it was significant for most of the studied traits, and this is due to the combined effect of soaking the seeds before planting and the effect of adding organic and mineral fertilization to the soil before planting,which affected plant growth and thus increase the overall productivity of the plant.

CONCLUSIONS

The seed soaking before planting has a significant effect on all the characteristics of vegetative growth, chemical characteristics, and quantitative characteristics of okra plant.

The addition of organic and mineral fertilizers together had a significant effect on the characteristics of vegetative growth, chemical properties, and quantitative characteristics.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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