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Growth, Yield Performance of Apple Trees by Adding Some Organic Treatments

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ABSTRACT

This study was conducted on "Ibrahimi" apple trees during 2020-2021 growing season. The trees, which were planted at a 5 × 5 m size in a private apple orchard in Youssoufia city, southwest of the Baghdad Governorate, were about 5 years old when they budded on quince rootstock. Experiment included adding zeolite in four levels; zero (Z1), 1 kg.tree-1 (Z2), 2 kg.tree-1 (Z3) and 3 kg.tree-1 (Z4) and three levels of peanut shells compost, without adding (P1), addition at 250 g.tree-1 (P2) and addition at 500 g.tree-1 (P3). Replications number was three (two trees in experimental unit) designed at factorial experiment in a R. C. B. D. number of trees used was 72 trees. Experimental results showed that interaction between zeolite and peanut shells compost had a major impact, particularly when interaction treatment (Z4P3) were given 22.22 cm2, 29.82 cm, 31.92 mg.g-1 fresh weight, and 36.06 % as leaf area, increase in shoot length, leaves chlorophyll content, and leaf dry weight, respectively. Moreover, given 2.00 %, 0.430 %, 1.88 % and 97.50 mg.kg-1, as leaf N, P, K and Fe content, respectively. As for yield characteristics, it has been given 41.23 g, 4.12 cm, 25.00 kg and 11.74 % as fruit weight, fruit diameter, tree yield and T.S.S, respectively. Finally, it can be concluded from this research that adding zeolite had an important role in improving availability of soil elements and organic matter, especially when this addition was combined with peanut shells compost and this effect had a positive impact on vegetative and fruit growth characteristics of apple trees.

***Keywords*:** Zeolite, organic fertilizer, peanut shells, apple, tree yield.

INTRODUCTION

In addition to being easily available in local stores, organic fertilizers are frequently inexpensive and environmentally friendly. They improve soil's capacity to hold water and boost plants' resistance to drought, among other beneficial effects. Additionally, they enhance soil aeration, which promotes root development and dissemination. They also boost different activities of microorganisms and their secretions, as well as availability of nutrients. These secretions are regarded as harmless fertilizers from a health standpoint and may be abundant in significant growth regulators. Whether sprayed on the vegetative group or added to the soil, organic matter gives plants nutrients without harming the environment. Those who work in the agricultural sector are well aware of the significance of organic matter and its influential role in the characteristics of vegetative growth of various types, as well as the yield and quality of fruits [1, 2, and 3]. In 1756, zeolite was found to be a naturally occurring material. Alkali metal cations are present in this sedimentary mineral, which is mostly made up of aluminosilicates with a three-dimensional crystalline network [4]. Countries like Japan, Turkey, Russia, South Africa, Bulgaria, and Hungary are among those that contain zeolite. By preserving soil moisture, zeolite boosts microorganism's activity, which are crucial to breakdown of organic matter that has been added to soil. Low amounts of water and nutrients in dry and semi-arid soils slow down plant growth by causing free radicals (ROS) to accumulate in the plant, which harms proteins, DNA, and the lipid membrane of cells, by activating antioxidant enzymes like peroxides and catalase, zeolite aids in removal of free radicals from plants [5, 6]. Natural zeolite has many advantages for soil, including ability to leach dissolved salts, increase water retention, decrease surface crust hardening, have high exchange properties, and have a high internal specific surface area. It is utilized as a natural fertilizer in conventional farming. Enhancing soil's physical, chemical, and biological qualities is another important effect. The mineral contributes significantly to gradual release of adsorbed nutrients, guaranteeing that plants will always have access to nutrients at every stage of growth [7, 8]. Some studies were conducted to determine effect of adding zeolite to yield and growth of fruit trees.[9],found in their study on effect of adding natural zeolite (Agrozel) to growth of apple trees at a concentration of 1 kg per tree in combination with addition of chemical fertilizer NPK and comparing it to no addition, that addition led to a significant increase in yield and leaf content of NPK and magnesium compared to no addition. [10], also found in their experiment on effect of adding five levels of natural zeolite (zero, 500,

1000, 2000 and 3000 g.tree^{-1}) to two olive cultivars that there was a significant increase in growth and leaf content of phosphorus, potassium and magnesium, especially when added at level of 3000 g tree^{-1}.

Management and disposal of plant waste is an important issue in both developing and developed countries, as it costs huge sums of money. In addition, organic waste is a source of pollution if it is not properly handled in way it is collected or disposed of. Currently, organically supported agricultural production is a rapidly emerging technology in world. It solves part of waste disposal problems by converting biodegradable waste into organic compost. This ensures availability of organic fertilizers for plant production. In addition, plants whose nutritional sources are organic provide opportunities to produce high-quality fruits due to reduction in amount of chemical fertilizers used throughout growth period. Among some wastes that are converted into compost and added to soil is peanut shell [11, 12]. Compost made from peanut shells can increase soil fertility and plant growth, particularly when used in part place of peat or other growing media. It is not advised to use compost made entirely of peanut shells, though, as this may hinder plant growth and nutrient availability and result in nutrient imbalances. Rather, adding it at moderate amounts (about 25–50%) can improve the qualities of the soil, increase the uptake of nutrients, and raise growth indicators like as biomass, height, and root development. It has many beneficial impacts, such as improving soil fertility by raising amount of carbon, nitrogen, phosphorus, and other nutrients; Improving soil characteristics. Additionally, by boosting porosity and cation-exchange capacity, it can enhance soil structure. Encourages plants growth ; Plant height, shoot and root biomass, root length, and general plant health can all be increased by adding peanut shell compost to a mix, according to studies. It might also raise amount of chlorophyll and Improves absorption of nutrients; Peanut shell compost can increase amount of nutrients that plants absorb. Both yield and its quality improve because of these effects [13, 14]. Grown all over world, apples (*Malus domestica* Borkh) are a significant member of Rosacea family. Since ancient times, it has been found in East Asia, having originated in southern Caucasus region. There are an estimated 2632229 productive apple trees in Iraq, and each tree can yield up to 79413 tons of fruit, with an average of 30.17 kg produced per tree. In terms of apple production, Baghdad governorate leads field, followed by Al-Anbar governorate and Salah al-Din governorate [15]. With a cultivated area of 4622366 hectares, global production in 2020 was 86442716 tons. China produces more apples than any other country, with 40,500,000 tons produced annually, and followed by United States of America, Turkey, Poland, and India [16]. Iraq's tree productivity is low when compared to other nations' production; this could be because trees are not given proper fertilization, irrigation, disease, and insect control, and post-harvest activities like harvesting, transportation, storage, and marketing are not given enough attention. There are not many experiments regarding addition of this compost and its effects on growth and yield of fruit trees, and its role and that of zeolite in water retention. Therefore, due to water scarcity and low soil fertility in Iraq, these two factors play a role in improving soil fertility and conserving water. The aim of this experiment was to know roles of these two factors in soil and plant content of some elements and growth characteristics and yield of "Ibrahimi" apple cultivar.

Materials And Methods

This study was conducted on "Ibrahimi" apple trees during 2020-2021 growing season. The trees, which were planted at a 5 × 5 m size in a private apple orchard in Youssoufia city, southwest of the Baghdad Governorate, where the soil is sandy loam, were about 5 years old when they budded on quince rootstock. Every tree that was engaged was in good health and almost the same size and vigor. The experimental trees were exposed to the standard agro-technical procedures for fertilizer, watering, pruning, and insect management that are typically used in commercial apple orchards. Experiment included adding zeolite in four levels; zero (Z_1), 1 kg.tree^{-1} (Z_2), 2 kg.tree^{-1} (Z_3) and 3 kg.tree^{-1} (Z_4) and three levels of peanut shells compost, without adding (P_1), addition at 250 g.tree^{-1} (P_2) and addition at 500 g.tree^{-1} (P_3). Replications number was three (two trees in experimental unit) designed at factorial experiment in a R. C. B. D. number of trees used was 72 trees. Decomposing peanut shells was added at beginning of December 2020, while the zeolites were added in mid-January. Orchard soil properties were analyzed before adding treatments as shown in Table 1. In mid-November 2021, soil analyses were conducted at conclusion of experiment, and nitrogen was calculated using the micro-Kjeldahl method as described in [17]. A spectrophotometer was used to quantify phosphorous at a wavelength of 882 nm using Olsen's technique, which was published in Page et al. [17]. Employing a flame photometer to estimate potassium content of prepared soil, as described in [17].In addition to using same approach of elements and examining soil organic matter. Leaf area (cm^2), increased shoot length (cm), leaf chlorophyll contents (mg.g-1 fresh weight) as per [18], leaf dry weight (%), and increased shoot length (cm) were the criteria of the vegetative study. while leaves mineral content were as follows: nitrogen (%) according [19], phosphor and potassium (%) according [20] and Fe (mg.kg^{-1}) according [21]. Some yield characteristics were also studied, such as fruit weight (g), fruit diameter (mm), yield per tree (kg), and T.S.S. According to [22], the results of study were statistically analyzed, and averages were compared using the (L.S.D.) at 0.05.

Table 1. Some Physical and Chemical Properties of orchard Soil Before treatments

Adjective	Unit	Value
Sand		66.6
Clay	%	16.4
Silt		17.0
Texture		Sandy loam
pH	-	7.40
O.M	%	1.60
N		65.00
P	$mg.kg^{-1}$	9.25
K		150.50

Results and discussions

Effects of Zeolite and peanut shells compost and their interaction on Availability of NPK and organic matter in Soil:

Data concerning effect of treatments on orchard soil N, P, K availability and organic matter during 2021 seasons are listed in Table (2).data cleared that, zeolite at 3 $kg.tree^{-1}$ (Z_4) significantly increased in soil N, P, and K availability and O.M at end of experiment, which amounted to 68.61 mg N kg^{-1} soil, 10.50 mg P kg^{-1} soil, 167.17 mg K kg^{-1} soil and 1.67 O.M %, respectively, while lower values of these traits was in Z_1 treatment. Table (2) also shows that peanut shells compost at 500 $g.tree^{-1}$ (P_3) superiority of control treatment and gave highest soil N, P, K availability and organic matter at end of experiment , which amounted to 73.40 mg N kg-1 soil, 10.95 mg P kg-1 soil, 169.55 mg K kg-1 soil and 1.72 O.M %, respectively. In addition, lower values of these traits were in control treatment (P_1). Availability of nitrogen, phosphorus, and potassium in the soil was greatly impacted by the interactions between zeolite and peanut shell compost, particularly in the interaction treatment (Z_4P_3), which produced soil nitrogen availability of 79.20 mg N kg^{-1}, soil phosphorus availability of 12.00 mg P kg^{-1}, soil potassium availability of 180.50 mg K kg^{-1}, and soil organic matter of 1.91 percent. This superiority in proportions of available elements in the soil may be due to fact that zeolite increases water use efficiency in soil and increases availability of essential nutrients. Also, adding zeolite with fertilizers gives a double result when placed in soil, as it provides a long-term effect for fertilizers (extending effect) and has the ability to absorb nutrients [23].Organic addition also caused a decrease in pH in rhizosphere and affected supply of most nutrients due to role of this compost in chelating cations and releasing them and increasing cation exchange capacity of the soil, which led to an increase in soil organic matter and availability of major elements [24].

Effects of Zeolite and peanut shells compost and their interaction on vegetative growth traits:

Table (3) showed that experimental factors had a significant impact on vegetative traits, results of Table (3) indicate that zeolite at 3 $kg.tree^{-1}$ (Z_4) has a significant effect on leaf area, increase in shoot length, leaves chlorophyll content and leaf dry weight of 21.28 cm^2, 24.24 cm, 29.69 $mg.g^{-1}$ fresh weight and 34.23 %, respectively, while no zeolite added (Z_1) gave lowest rates of these traits. Same table's results also show that compost fertilization treatment with peanut shells (P_3) produced highest average leaf area, increase in shoot length, leaves chlorophyll content, and leaf dry weight compared to other treatments. It produced 20.59 cm^2, 25.51 cm, 29.75 $mg.g^{-1}$ fresh weight, and 33.57%, respectively, while the control treatment P_1 had the lowest rates for this trait. Interactions between zeolite and peanut shells compost had a major impact, particularly when interaction treatment (Z_4P_3) was given 22.22 cm^2, 29.82 cm, 31.92 $mg.g^{-1}$ fresh weight, and 36.06 % as leaf area, increase in shoot length, leaves chlorophyll content, and leaf dry weight, respectively. It is clear from results of Table (3) that zeolite addition has a significant effect on vegetative growth of apple trees; three $kg.tree^{-1}$ gave a significant increase in all vegetative growth traits.

Table 2. Effects of Zeolite and peanut shells compost and their interaction on Availability of NPK and organic matter in orchard Soil

	mg N kg^{-1}				mg P kg^{-1}			
Z	P				P			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Z_1	52.55	58.90	66.70	59.38	8.90	9.20	10.30	9.47
Z_2	54.90	64.82	72.10	63.94	9.15	9.50	10.30	9.65
Z_3	55.80	68.20	75.60	66.53	9.40	9.80	11.20	10.13
Z_4	55.88	70.74	79.20	68.61	9.55	9.95	12.00	10.50
Mean	54.78	65.67	73.40		9.25	9.61	10.95	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	2.75	2.38	4.76		0.27	0.23	0.46	
	mg K kg^{-1}				O.M (%)			

Z_1	140.40	155.60	158.50	151.50	1.12	1.25	1.55	1.31
Z_2	145.60	162.20	166.70	158.17	1.18	1.36	1.64	1.39
Z_3	145.00	166.00	172.50	161.17	1.28	1.50	1.78	1.52
Z_4	150.50	170.50	180.50	167.17	1.36	1.73	1.91	1.67
Mean	145.38	163.58	169.55		1.24	1.46	1.72	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	4.69	4.06	8.12		0.09	0.08	0.16	

Table 3. Effects of Zeolite and peanut shells compost and their interaction on vegetative growth traits of "Ibrahimi" apple trees

	Leaf area (cm^2)				Shoot length (cm)			
Z	P				P			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Z_1	17.90	18.26	18.68	18.28	16.93	18.90	20.80	18.88
Z_2	18.16	19.33	20.26	19.25	18.11	20.27	23.40	20.59
Z_3	18.57	19.96	21.18	19.90	18.94	25.14	28.00	24.03
Z_4	20.13	21.48	22.22	21.28	17.22	25.69	29.82	24.24
Mean	18.69	19.76	20.59		17.80	22.50	25.51	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	0.60	0.52	1.04		1.45	1.26	2.52	
	Leaf chlorophyll contents (mg.g-1 fresh weight)				Leaf dry weight (%)			
Z_1	24.16	25.30	27.20	25.72	29.16	30.64	31.28	30.36
Z_2	24.87	26.77	29.40	27.01	30.32	31.29	32.42	31.34
Z_3	25.11	28.31	30.48	27.97	32.26	33.00	34.50	33.25
Z_4	26.80	30.34	31.92	29.69	32.78	33.85	36.06	34.23
Mean	25.24	27.68	29.75		31.13	32.20	33.57	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	0.95	0.82	1.63		0.69	0.60	1.20	

This increase in vegetative growth characteristics may be due to nitrogen content of soil (Table 2) and apple tree leaves (Table 4). This is due to zeolite's ability to retain nitrogen and prevent its loss from soil, which in turn leads to increased uptake by plant, leading to an increase in vegetative growth rate of the trees [25]. Nitrogen is also essential for plant protein synthesis, thus increasing dry weight of the leaves. This reason may also be attributed to fact that zeolite granules work primarily to reduce the soil's mechanical resistance to root system, thus increasing length of roots and increasing their absorption, which is reflected in vegetative growth of trees. Zeolite has ability to exchange cations, including calcium, potassium and ammonium, which are useful in root growth [26], and thus plant roots absorb more of these ions. Addition of compost made from peanut shells is responsible for increase in studied vegetative characteristics of apple trees. This is because it contributes to soil's increased percentage of organic matter (Table 2), which in turn causes soil particles to bind and aggregate more, improving soil's composition and increasing the amount of elements available to plants (Table 2) for vegetative growth. Furthermore, a higher proportion of organic matter in the soil promotes soil regeneration activity, which in turn promotes organic matter mineralization and the subsequent release of elements, particularly nitrogen, which is essential for tree vegetative growth [27, 28].

Effects of Zeolite and peanut shells compost and their interaction on leaf Fe, N, P and K content:

Results of Table (4) demonstrated that experimental factors significantly affected amount of minerals in leaves. The addition of zeolite at a rate of three kg.tree^{-1} (Z_4) produced highest levels of N, P, K, and Fe in the leaves, at 1.94 percent, 0.417%, and 94.21 mg.kg-1, respectively, while lowest levels of these minerals were obtained without zeolite addition (Z_1). In terms of leaf N, P, K, and Fe content, results of same table also demonstrate that fertilization treatment with peanut shell compost (P_3) was significantly better than other treatments. It produced 1.91 percent, 0.420 percent, 1.79 percent, and 92.34 mg.kg-1, respectively, while control treatment P_1 had the lowest rates for these minerals. Interactions between zeolite and peanut shells compost had a major impact, particularly when interaction treatment (Z_4P_3) was given 2.00 %, 0.430 %, 1.88 % and 97.50 mg.kg^{-1}, as leaf N, P, K and Fe content, respectively. Results in Table (4) show that zeolite has a significant effect on leaves content of elements; Zeolite is characterized by its ability to preserve elements in soil, especially nitrogen, due to absorption of ammonium on surfaces of zeolite and reducing process of its loss in soil. Its interaction with organic and mineral fertilizers also resulted in good levels of elements in the plant because of building a good root system that helped in absorbing ready nutrients from the soil and thus increasing them in leaves of trees. In addition, this is because zeolite mineral added to soil enhanced plant growth and improved plant's chemical composition. Addition of compost raises concentration of certain

elements in leaves because it increases amount of those elements in the soil, which in turn promotes growth of root mass and, consequently, absorption of nutrients [28, 29].

Table 4. Effects of Zeolite and peanut shells compost and their interaction on leaf N, P, K and Fe content of "Ibrahimi" apple trees

Z	N (%)				P (%)			
	P				P			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Z_1	1.68	1.74	1.76	1.73	0.380	0.399	0.410	0.396
Z_2	1.77	1.81	1.89	1.82	0.386	0.406	0.417	0.403
Z_3	1.77	1.88	1.97	1.87	0.395	0.411	0.421	0.409
Z_4	1.86	1.95	2.00	1.94	0.405	0.416	0.430	0.417
Mean	1.77	1.85	1.91		0.392	0.408	0.420	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	0.03	0.03	0.06		0.014	0.012	0.024	
	K (%)				Fe ($mg.kg^{-1}$)			
Z_1	1.60	1.65	1.68	1.64	83.20	85.76	87.12	85.36
Z_2	1.63	1.70	1.76	1.70	87.19	88.93	90.60	88.91
Z_3	1.69	1.70	1.82	1.74	88.48	90.67	94.12	91.09
Z_4	1.64	1.78	1.88	1.77	90.95	94.18	97.50	94.21
Mean	1.64	1.71	1.79		87.46	89.89	92.34	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	0.029	0.025	0.050		1.32	1.14	2.27	

Effects of Zeolite and peanut shells compost and their interaction on fruit traits:

Table (5) showed that experimental factors had a significant impact on yield characteristics; results of Table (5) indicate that zeolite at three $kg.tree^{-1}$ (Z_4) has a significant effect on fruit weight, fruit diameter, tree yield and T.S.S of 38.27 g, 3.90 cm, 23.03 kg and 11.24 %, respectively, while no zeolite added (Z_1) gave lowest rates of these traits. Same table's results also show that compost fertilization treatment with peanut shells (P_3) produced highest averages of fruit weight, fruit diameter, tree yield and T.S.S compared to other treatments. It produced 38.26 g, 3.79 cm, 23.03 kg and 11.32 %, respectively, while the control treatment P_1 had lowest rates for this trait. Interactions between zeolite and peanut shells compost had a major impact, particularly when interaction treatment (Z_4P_3) were given 41.23 g, 4.12 cm, 25.00 kg and 11.74 % as fruit weight, fruit diameter, tree yield and T.S.S, respectively. Increase in these properties is due to role of zeolite as an improver of some soil fertility and physical properties, and thus an increase in yield properties, thanks to its unique properties. The ion exchange properties of zeolite can be used in agriculture due to its high porosity and high cation exchange capacity [30]. This superiority is also due to the role of organic fertilizer in increasing the availability of nitrogen and phosphorus in soil (Table 2) and protecting them from fixation processes due to secretion of some enzymes and organic acids through the activity of microorganisms. Consequently, vegetative growth properties improved (Table 3) and leaf element content (Table 4), and thus studied yield properties improved [27].

Table 5. Effects of Zeolite and peanut shells compost and their interaction on yield characteristics of "Ibrahimi" apple trees

Z	Fruit weight (g)				Fruit diameter (cm)			
	P				P			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
Z_1	32.78	33.24	34.92	33.65	2.98	3.20	3.38	3.19
Z_2	33.19	35.80	36.85	35.28	3.12	3.59	3.72	3.48
Z_3	35.67	36.90	39.94	37.50	3.27	3.71	3.94	3.64
Z_4	36.00	37.58	41.23	38.27	3.55	3.74	4.12	3.90
Mean	34.41	35.88	38.26		3.23	3.56	3.79	
L.S.D 5%	Z	P	Int.		Z	P	Int.	
	1.21	1.05	2.10		0.14	0.12	0.24	
	Tree yield (kg)				T.S.S (%)			
Z_1	19.15	19.90	20.88	19.97	10.20	10.62	10.78	10.53
Z_2	19.48	21.26	22.40	21.05	10.90	11.02	11.18	11.03
Z_3	21.00	21.86	23.82	22.23	10.42	11.28	11.56	11.09
Z_4	21.17	22.92	25.00	23.03	10.58	11.40	11.74	11.24
Mean	20.20	21.49	23.03		10.53	11.08	11.32	

L.S.D 5%	Z	P	Int.	Z	P	Int.
	0.47	0.41	0.82	0.15	0.13	0.25

Conclusion

According to the obtained results, it can be concluded from this research that adding zeolite had an important role in improving availability of soil elements and organic matter, especially when this addition was combined with peanut shells compost and this effect had a positive impact on vegetative and fruit growth characteristics of apple trees. Finally, it can be recommend that adding these treatments to soil of fruit trees or increasing concentration of these treatments on other fruit trees and in other locations.

Author contribution

Mustafa, E. A. AL-Hadethi wrote the manuscript, conducted the field experiments, prepared the materials used, performed the statistical analyses and supported the field implementation.

Mohamed A. El-Sherpiny contributed to the development of the scientific methodology, provided critical scientific review, and performed language editing.

All authors approved the final version of the manuscript.

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نمو وكفاءة حاصل أشجار التفاح بإضافة بعض المعاملات العضوية

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الخلاصة

أجريت هذه الدراسة على أشجار تفاح "الإبراهيمي" خلال موسم النمو 2020 -2021. زُرعت الأشجار على مساحة 5 × 5 أمتار في بستان تفاح خاص بمدينة اليوسفية، جنوب غرب محافظة بغداد، وكان عمرها حوالي 5 سنوات المطعمة على أصل السفرجل. تضمنت عوامل تجربة الدراسة إضافة الزيولايت بأربعة مستويات؛ صفر ***(Z1)***، 1 كجم شجرة-1 ***(Z2)***، 2 كجم شجرة-1 (***Z3***) و3 كجم شجرة-1 (***Z4***) وثلاثة مستويات من سماد قشور الفول السوداني، بدون إضافة (***P1***)، إضافة بمعدل 250 جم شجرة-1 (***P2***) وإضافة بمعدل 500 جم شجرة-1 (***P3***). بلغ عدد المكررات ثلاثة (شجرتان في الوحدة التجريبية) مصممة لتجربة عامليه في نظام ***R. C. B. D***. بلغ عدد الأشجار المستخدمة 72 شجرة. أظهرت النتائج التجريبية أن التداخل بين الزيولايت وسماد قشور الفول السوداني كان له تأثير كبير، خاصةً عند معاملة التداخل (***Z4P3***) اذ اعطت 22.22 سم2، 29.82 سم، 31.92 ملغم/غم-1 وزنًا طرياً، و36.06% كمساحة ورقة، وزيادة في طول البراعم، ومحتوى الكلوروفيل في الأوراق، ووزن الورقة الجاف، على التوالي. علاوة على ذلك، اعطت 2.00%، 0.430%، 1.88%، و97.50 ملغم/غم-1 كمحتوى للأوراق من النيتروجين والفوسفور والبوتاسيوم والحديد، على التوالي. أما بالنسبة لصفات الحاصل، فقد أعطت 41.23 غ، 4.12 سم2، 25.00 كغم، و11.74% كوزن ثمرة، وقطر ثمرة، وحاصل الشجرة، ونسبة المواد الصلبة الذائبة الكلية، على التوالي. وأخيراً يمكن الاستنتاج من هذا البحث أن إضافة الزيولايت كان له دور مهم في تحسين توفر العناصر الجاهزة في التربة وخاصة عند تداخل هذه الإضافة مع كمبوست قشور الفول السوداني وكان لهذا التداخل تأثير إيجابي على صفات النمو الخضري والثمري لأشجار التفاح.

الكلمات المفتاحية: الزيولايت ، السماد العضوي ، قشور الفول السوداني ، التفاح، حاصل الشجرة .