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Effect of local isolated endomycorrhizal fungi on the growth of *Cucurbita pepo* and *Citrullus lanatus* seedling, an alternative method to chemical fertilizers

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Abstract
This research aim to study the influence of local endosymbiotic fungus on the growth of two important plants, which are squash and melon. Therefore, we begin our study by obtaining the fungus from the roots of squash seedlings cultured near an agricultural area. The roots containing the fungus mycelia were cultured on PDA media. The seedlings of two plants have been germinate on vermiculite substrates containing little amount of organic matters.
20 days later, we inoculated a part of seedlings with the symbiotic fungus by placing the media containing the roots and the fungus hypha near the roots of seedlings.
Three months later, the measure of the impact of symbiotic fungus on the plant growth was taken by comparing between inoculated plants, the control plants and plants treated with specific chemical fertilizer.
The results show a net positive influence of the symbiotic fungus on the growth of squash seedling comparing with control and with the seedling treated with chemical fertilizers especially root systems. Concerning melon plants, the positive effect of the fungus was only comparing with control. We can conclude that the use of Am fungus give a real positive influence on the growth of plants especially comparing with control and better or similar compared with plant treated by chemical fertilizer.

Keywords: Mycorrhization, arbuscular mycorrhiza, (AM) watermelon, summer squash

Introduction
Symbiosis is defined as "two or more organisms living together" and in most cases both partners benefit (Lewis 1985) [9]. There are many types of symbiosis evolving different combinations of plants, fungi, microbes and animals. Fungal symbioses (Mycorrhization) have been defined as "all associations where fungi come into contact with host (plant roots) from which they obtain, in a variety of ways, either metabolites or nutrients" (Cook 1977) [7].
Of the seven famous types of mycorrhizae classified (arbuscular, ecto, ectendo-, arbutoid, monotropoid, ericoid and orchidaceous mycorrhizae), arbuscular mycorrhizae and ectomycorrhizae are the most abundant and widespread (Smith and Read, 1997; Allen *et al.*, 2003) [18, 1]. Arbuscular mycorrhizal (AM) fungi comprise the most common mycorrhizal association and form mutualistic relationships with over 80% of all vascular plants (Brundrett, 2002) [5].
Arbuscular mycorrhizae (AM) are the most common mycorrhizal type. They are formed in an enormously wide variety of host plants by obligatory symbiotic fungi, which have recently been reclassified based on DNA sequences into a separate fungal phylum, the Glomeromycota (Schüβler *et al.*, 2001) [19].
AM fungi are obligate mutualists belonging to the phylum Glomeromycota and have a ubiquitous distribution in global ecosystems (Redecker *et al.*, 2000) [17].
It has recently been discovered that several species of tropical achlorophyllous epiphytes form mycorrhizal associations with AM fungal species in the Glomeromycota (Bidartondo *et al.*, 2002) [4].
It seems highly likely that the fungi had their origins possibly over 1000 million years ago, (predating current estimates of colonization of land) and that arbuscular mycorrhizal (AM) symbioses are extremely ancient.

AM fungi (AMF) help plants to capture nutrients such as phosphorus and micronutrients from the soil. It is believed that the development of the arbuscular mycorrhizal symbiosis played a crucial role in the initial colonization of land by plants and in the evolution of the vascular plants. They induce greater resistance to soil pathogens, enhance tolerance to drought stress, and reduce sensitivity to toxic substances occurring in the soil (Brundrett, 2002) [5].

It is very important to prove scientifically that symbiosis especially mycorrhization possible to be an alternative to chemical fertilization.

The importance of this idea is reflected in a distinct area like Gaza, where the density of population is high and there is an intensive agriculture in a narrow agricultural area. This situation forcing the farmers to excessive use of chemical fertilizers to compensate the deficiency of the agricultural land used.

This situation become more dangerous due the sandy nature of the soil that facilitate the arrival of these chemicals into the groundwater through the irrigation causing a significant pollution of drinking water. It is worth mentioning that the only source of drinking water in this region of the world is the groundwater. On the other hand, increases of the incidence of cancer due to the entry of these substances in the food chain of the population. The Palestinian Ministry of Health (PMOH) 2016, report shows that there are 80 injury cases per 100,000 inhabitants per year, a rate of 125 cases per month.

Putting effective alternatives for these farmers is of utmost importance to begin to develop a strategy aimed to reduce the use of chemical fertilizers, while maintaining appropriate agricultural production.

This is the ultimate goal of such researches that fall within an integrated system aimed at preserving the environment, drinking water, health and at the same time providing a high agricultural productivity.

Methodology

A- Fungi

In order to get the largest proportion of our target symbiotic fungus, 30 seedlings of summer squash plants were planted in sandy soil with little quantity of organic matters. The area where we planted the seedling is relatively distant from agricultural lands where the chemical fertilizers frequently used, so we can avoid the arrival of these materials to our seedling. After 30 days of culture, seedlings were uprooted and prepared for the isolation of the fungus.

Isolation and multiplication of fungus

For obtaining a pure culture of fungus from mycorrhizal, roots were separated from shoots and washed with running water and disinfected by different concentrations of Sodium hypochlorite ranging from 2 to 10% during 1 to 10 minutes and then washed again with sterile water. All these steps took place in an axenic condition. The roots then cultured in a MMN media, the media components as shown in the table1.

Table1: Culture Media (MMN) (Marx 1969)

$CaCL_2$	0.05 g	Thiamine HCL	100m
NaCL	0.025 g	Malt Extract	3g
KH_2PO_4	0.5 g	Sucrose	10g
$(NH_4)_2 HPO_4$	0.25	Bacto – agar (optional)	15 g
$MgSO_4 7H_2O$	0.15	H_2O	1000ml
$FeCL_3$	1.2 ml		

After 7 days of culture, we obtained a heavy growth of fungus mycelia in Petri dishes, the fungus mycelia were subcultured many times.

B- Plants

Two types of plants of the same family were selected, watermelon (*Citrullus lanatus*) and summer squash (*Cucurbita pepo*). These seasonal plants are grown widely in the Gaza Strip, which rely on chemical fertilizers.120 seedlings of each species planted inside a Mimi-green house.

C- *In vitro* inoculation of plant by fungi

The experimental soils were prepared by mixing three parts of vermiculite with one part of compost. The soils was treated by autoclaving. 800 ml soil samples were taken in each pot. 240 pots of soil were used for the culture of Squash and Watermelons plants, 120 pots for each type. Four sets of experiments were conducted, each set consist 30 pots with 30 seedlings. First set, control (sterilized soil without any kind of fertilizer). Second set, roots directly inoculated with fungus mycelia. Third set, roots treated each 2 weeks with 100 ml of chemical fertilizer (Suspension of Shifah see Annex). For the fourth set, roots, inoculated by injection of 10 ml/ pot (approx. 200 spores) of fungus spores suspension. Fungus spores suspension (contains about 25-30 spores/ml) was prepared under sterile conditions by gently mixed 30 ml of sterile water with the mycelia taken from 1 or 2 Petri dishes (Limpens *et al*. 2004) [10]. Watermelon and squash plants were incubated after the application of previous experience in the green house for two months. After the end of the incubation, samples were taken from the roots and were dug very carefully to get most of the finer roots. Root samples were cleaned, cut into 1 cm segments (Hayman, 1974) [8] and stained according to the method described by Phillips and Hayman (1970) [14]. The root segments were then observed under a microscope. The result was determined by comparing the difference between dry weights of mycorrhizal and non-mycorrhizal plants.

D. Statistical analysis

Data were collected and computed by using version 20 of Statistical Package for Social Science, (SPSS). One way ANOVA was the main statistical test used in our study.

Results

1. The occurrences and intensity of colonization of roots by AMF

Segments of roots for fungus spores suspension treatment plants after cleaning and staining according to the method described by Phillips and Hayman (1970) [14] examined under the microscope and the results were as in (Figure IV.1, Figure IV.2). Summer squash (*Cucurbita pepo*) and watermelon (*Citrullus lanatus*) plants were colonized by AMF as indicated by the presence of hyphae and vesicles. There were no signs of AMF colonization in the roots of control plants (Figure IV.1, Figure IV.2).

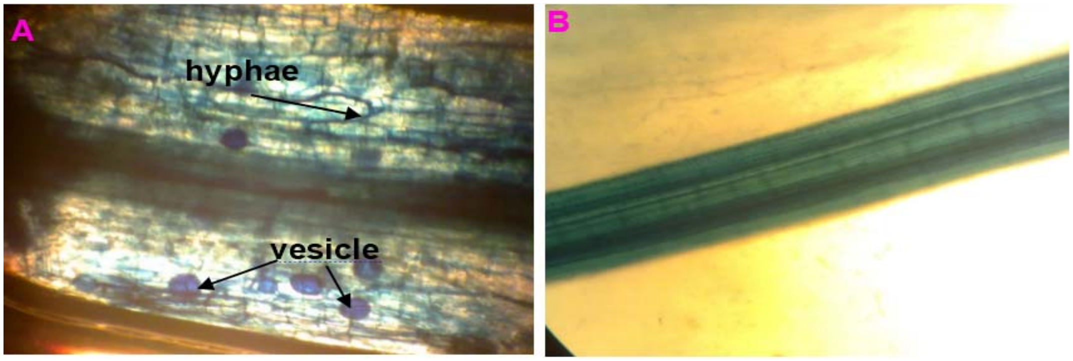

Fig 1: The occurrences and intensity of root colonization of AMF in summer squash plants. A. colonization in roots for fungus spore suspension treated plants, B. roots of control plants.

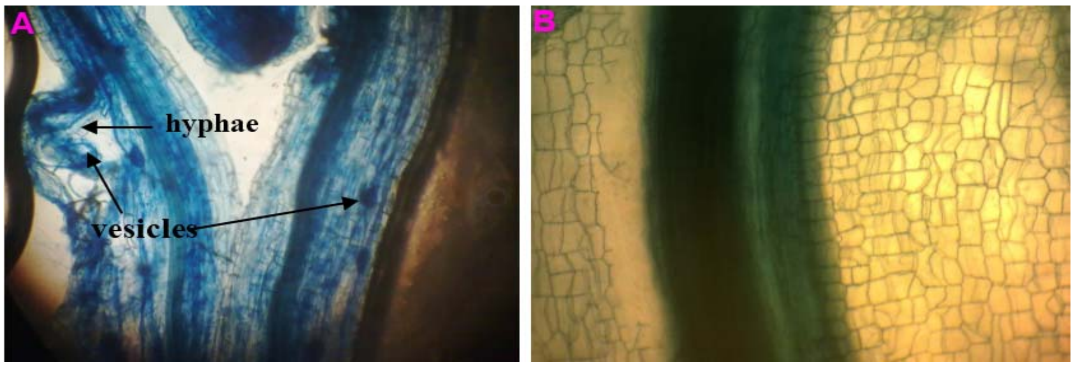

Fig 2: The occurrences and intensity of root colonization of AMF in watermelon plants. A. colonization in roots for fungus spore suspension treated plants, B. roots of control plants.

2. Growth of watermelon and summer squash plants

The study included squash and watermelon plants treated with fungus spores suspension or as a control, no treatment. As can be shown in (fig.3 and 4), the shoot growth was larger in fungus spores suspension treated plants than the control plants.

Fig 3: Growth of summer squash plants. Experimental pots treatment with fungus spores suspension (K1) control soil (K2) for summer squash plants.

Fig 4: Growth of watermelon plants. Experimental pots treatment with fungus spores suspension (k1), control soil (K2) for watermelon plants.

I- summer squash plants (Dry weights)

A- Shoot

In order to be able to numerically compare the growth of fungus spores suspension treated plants versus the control and chemical fertilizers treated plants, we will consider the dry weight of the shoots or the roots together or independently. Table 1 shows the mean dry weight of summer squash shoots, the mean dry weight of chemically treated plants is higher than that of fungus spores suspension treated and both are higher than the control plants. The mean difference is statistically significant in the case of chemical fertilizer treatment (P value = 0.00) and fungus spores suspension (P value = 0.002) compared to control and not significant in the case of fungus mycelia directly (Table 2).

Table 1: Mean of shoot dry weight (summer squash)

Experiments	N	* Mean	Std. Deviation
Fungus mycelia directly	27	2.296	.3985
Fungus spores suspension	27	2.719	.6433
Chemical fertilizer	27	3.112	.3997
Control	27	2.319	.3793

* The mean of 27 independent experiments N: Number of experiments

Table 2: Comparison of the shoot dry weight means for different experiments (summer squash)

(I) experiments	(J) experiments	Mean Difference (I-J)	P value
Fungus mycelia directly	Fungus spores suspension	-.4222-*	.001
	Chemical fertilizer	-.8159-*	.000
	control	-.0222-	.862
Fungus spores suspension	Fungus mycelia	.4222*	.001
	Chemical fertilizer	-.3937-*	.003
	control	.4000*	.002
Chemical fertilizer	Fungus mycelia	.8159*	.000
	Fungus spores suspension	.3937*	.003
	control	.7937*	.000
Control	Fungus mycelia	.0222	.862
	Fungus spores suspension	-.4000-*	.002
	Chemical fertilizer	-.7937-*	.000

* The mean difference is significant at the. 05 level.

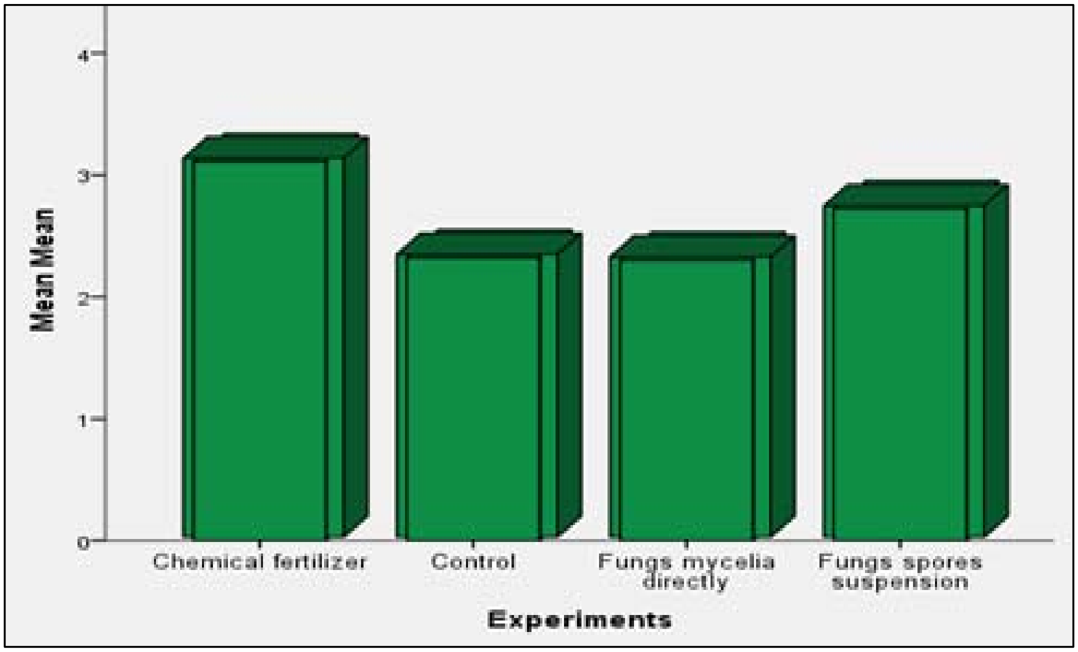

Fig 5: Mean of shoots dry weight (summer squash).

B- Roots

Table 3. shows the mean dry weight of summer squash roots the mean dry weight of fungus spores suspension treated plants is higher than that of control plants and both are higher than the chemically fertilizers treated. The mean difference is statistically significant in the case of fungus spores suspension (P value = 0.003) compared to control and (P value = 0.000) compared to chemical fertilizer (Table 4).

Table 3: Mean of roots dry weight (summer squash)

Experiments	N	* Mean	Std. Deviation
Fungus mycelia directly	27	.194	.0620
Fungus spores suspension	27	.333	.0877
Chemical fertilizer	27	.244	.0641
Control	27	.270	.0869

* The mean of 27 independent experiments N: Number of experiments

Table 4: Comparison of the roots dry weight means for different experiments (summer squash)

(I) experiments	(J) experiments	Mean Difference (I-J)	P value
Fungus mycelia directly	Fungus spores suspension	-.1396-*	.000
	Chemical fertilizer	-.0507-*	.016
	control	-.0767-*	.000
Fungus spores suspension	Fungus mycelia	.1396*	.000
	Chemical fertilizer	.0889*	.000
	Control	.0630*	.003
Chemical fertilizer	Fungus mycelia	.0507*	.016
	Fungus spores suspension	-.0889-*	.000
	Control	-.0259-	.214
Control	Fungus mycelia	.0767*	.000
	Fungus spores suspension	-.0630-*	.003
	Chemical fertilizer	.0259	.214

* The mean difference is significant at the. 05 level.

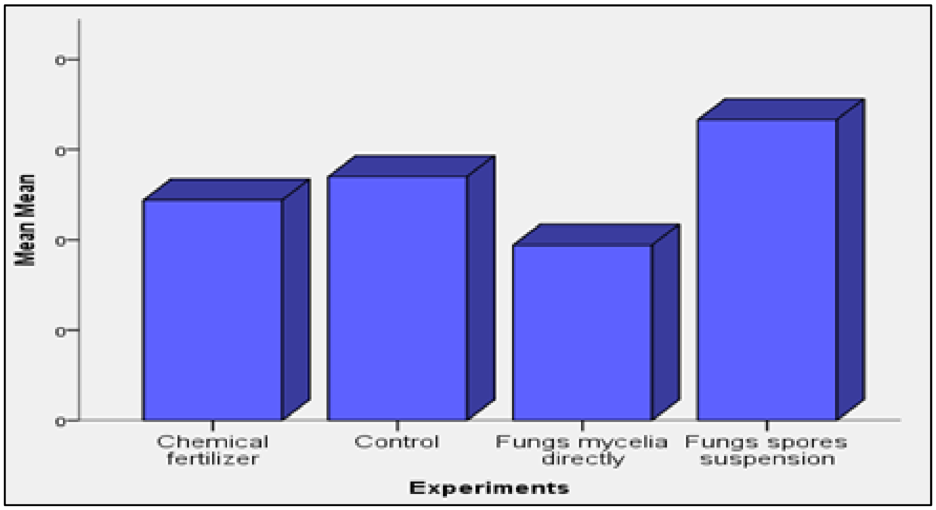

Fig 6: Mean of roots dry weight (summer squash).

C- Whole plant

Table 5. Shows the mean dry weight of the whole plant (shoot and root) for summer squash plant. The mean dry weight of chemically treated plants is higher than that of fungus spores suspension treated and both are higher than the control plants and fungus mycelia directly. The mean difference is statistically significant in the case of chemical treatment (P value = 0.00) and fungus spores suspension (P value = 0.005) compared to control and not significant in the case of fungus mycelia directly (P value = 0.467) (Table 6.).

Table 5: Mean of dry weight for the whole plant (summer squash)

Experiments	N	* Mean	Std. Deviation
Fungus mycelia directly	27	2.490	.4130
Fungus spores suspension	27	2.974	.6631
Chemical fertilizer	27	3.357	.4274
Control	27	2.589	.4423

* The mean of 27 independent experiments. N: Number of experiments.

Table 6: Comparison of the dry weight of the whole plant means for different experiments (summer squash)

(I experiments)	(J) experiments	Mean Difference (I-J)	P value.
Fungus mycelia directly	Fungus spores suspension	-.4841-*	.001
	Chemical fertilizer	-.8667-*	.000
	Control	-.0989-	.467
Fungus spores suspension	Fungus mycelia	.4841*	.001
	Chemical fertilizer	-.3826-*	.006
	Control	.3852*	.005
Chemical fertilizer	Fungus mycelia	.8667*	.000
	Fungus spores suspension	.3826*	.006
	Control	.7678*	.000
Control	Fungus mycelia	.0989	.467
	Fungus spores suspension	-.3852-*	.005
	Chemical fertilizer	-.7678-*	.000

* The mean difference is significant at the. 05 level.

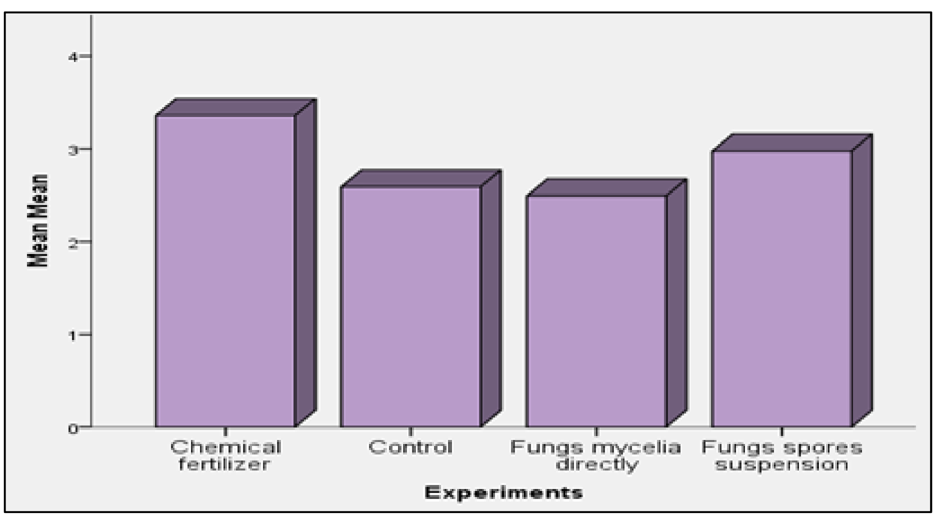

Fig 7: Mean of roots dry weight of whole plants (summer squash).

I- Watermelon plants (Dry weights)

A- Shoot

Table 7. Shows the mean dry weight of watermelon shoots the mean dry weight of chemically treated plants is higher than that of fungus spores suspension treated and both are higher than the control plants. The mean difference is statistically significant in the case of chemical treatment (P value = 0.002) and fungus spores suspension (P value 0.008) compared to control (Table 8.).

Table 7: Mean of shoot dry weight (watermelon)

Experiments	N	*Mean	Std. Deviation
Fungus mycelia directly	28	2.826	.5625
Fungus spores suspension	28	3.004	.4887
Chemical fertilizer	28	3.068	.5410
Control	28	2.621	.5087

* The mean of 28 independent experiments N: Number of experiments

Table 8: Comparison of the shoot dry weight means for different experiments (watermelon)

(I) experiments	(J) experiments	Mean Difference (I-J)	P value
Fungus mycelia directly	Fungus spores suspension	-.1771	.210
	Chemical fertilizer	-.2414	.089
	Control	.2050	.148
Fungus spores suspension	Fungus mycelia	.1771	.210
	Chemical fertilizer	-.0643	.648
	Control	.3821*	.008
Chemical fertilizer	Fungus mycelia	.2414	.089
	Fungus spores suspension	.0643	.648
	Control	.4464*	.002
Control	Fungus mycelia	-.2050	.148
	Fungus spores suspension	-.3821*	.008
	Chemical fertilizer	-.4464*	.002

* The mean difference is significant at the. 05 level.

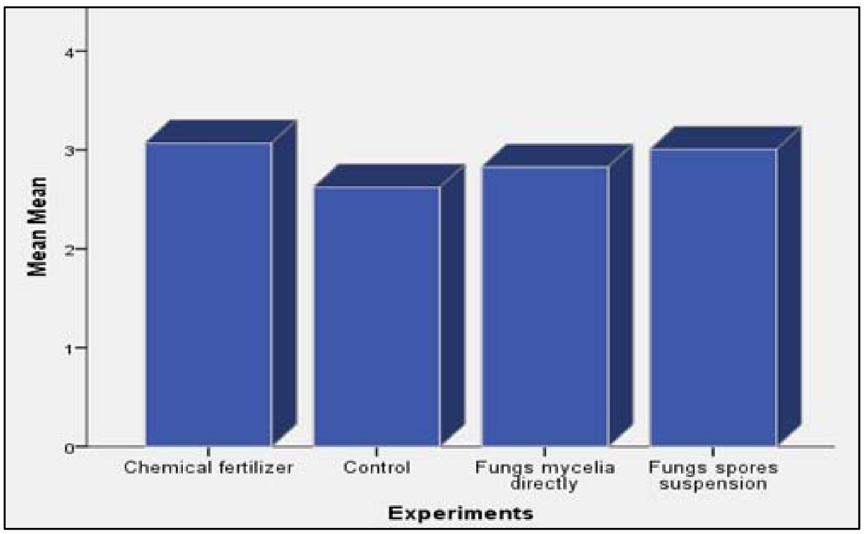

Fig 8: Mean of shoots dry weight (Watermelon).

B- Roots

Table 9. Shows the mean dry weight of watermelon (Citrullus *lanatus*) roots the mean dry weight of chemically treated plants and fungus spores suspension is higher than that of control plants. The mean difference is statistically significant in the case of fungus spores suspension treatment (P value = 0.009) compared to control and the mean difference is not statistically significant in the case of fungus spores suspension (P value = 0.180) compared to chemical fertilizer (Table 10.).

Table 9: Mean of roots dry weight (watermelon)

Experiments	N	* Mean	Std. Deviation
Fungus mycelia directly	28	.261	.0875
Fungus spores suspension	28	.312	.0686
Chemical fertilizer	28	.339	.0786
Control	28	.257	.0690

* The mean of 28 independent experiments N: Number of experiments

Table 10: Comparison of the roots dry weight means for different experiments (watermelon)

(I) experiments	(J) experiments	Mean Difference (I-J)	P value
Fungus mycelia directly	Fungus spores suspension	-.0511*	.014
	Chemical fertilizer	-.0786*	.000
	Control	.0036	.861
Fungus spores suspension	Fungus mycelia	.0511*	.014
	Chemical fertilizer	-.0275	.180
	Control	.0546*	.009
Chemical fertilizer	Fungus mycelia	.0786*	.000
	Fungus spores suspension	.0275	.180
	Control	.0821*	.000
Control	Fungus mycelia	-.0036	.861
	Fungus spores suspension	-.0546*	.009
	Chemical fertilizer	-.0821*	.000

* The mean difference is significant at the. 05 level.

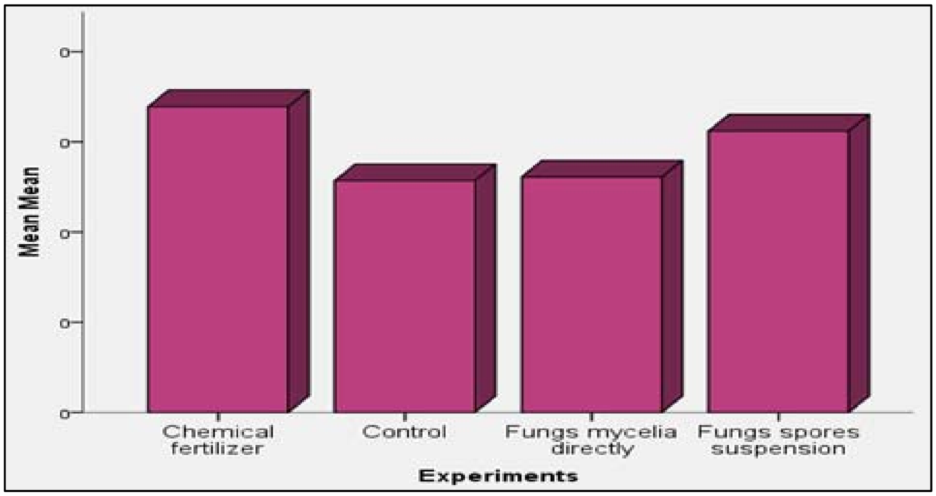

Fig 9: Mean of roots dry weight (Watermelon)

C- Whole plant

Table 11. Shows the mean dry weight of water melon shoot and root together (the whole plant) the mean dry weight of chemically treated plants is higher than that of fungus spores suspension treated and both are higher than the control plants and fungus mycelia directly. The mean difference is statistically significant in the case of chemical treatment (P value = 0.00) and fungus spores suspension (P value = 0.003) compared to control and the mean difference of fungus mycelia directly is not statistically significant (P value = 0.156) compared to control (Table 12).

Table 11: Mean of dry weight of the whole plant (watermelon)

Experiments	N	*Mean	Std. Deviation
Fungus mycelia directly	28	3.087	.6056
Fungus spores suspension	28	3.318	.5121
Chemical fertilizer	28	3.407	.5409
Control	28	2.879	.5209

* The mean of 28 independent experiments N Number of experiments

Table 12: Comparison of the dry weight of the whole plant means for different experiments (watermelon)

(I) experiments	(J) experiments	Mean Difference (I-J)	P value
Fungus mycelia directly	Fungus spores suspension	-.2307-	.117
	Chemical fertilizer	-.3200-*	.030
	Control	.2086	.156
Fungus spores suspension	Fungus mycelia	.2307	.117
	Chemical fertilizer	-.0893-	.542
	Control	.4393*	.003
Chemical fertilizer	Fungus mycelia	.3200*	.030
	Fungus spores suspension	.0893	.542
	Control	.5286*	.000
Control	Fungus mycelia	-.2086-	.156
	Fungus spores suspension	-.4393-*	.003
	Chemical fertilizer	-.5286-*	.000

* The mean difference is significant at the. 05 level.

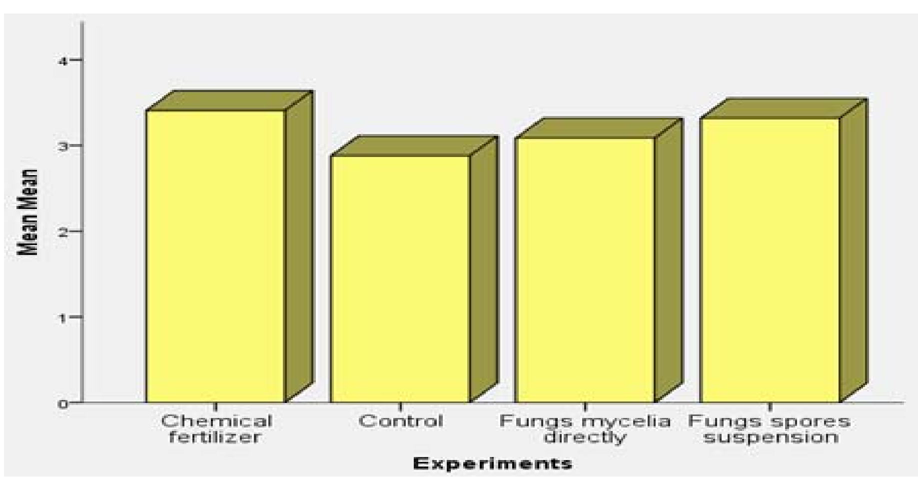

Fig 10: Mean of roots dry weight of whole plants (Watermelon).

Discussion

Soil fungi are playing an essential role in equilibrium of ecosystem either by parasitic, symbiotic, saprophytic. Despite its negative role in causing a number of plant diseases, its positive effects are particularly important. It symbiotic effect is considered a main source of minerals nutrition for a number of plants and trees. It is noteworthy to mention that symbiotic plants represent more than 95% of all plants (Smith and Read, 1997) [18]. Moreover, limited agricultural areas with intensive agriculture are particularly in need of such as symbiotic organisms in order to limit the use of chemical fertilizers and reduce the ground water pollution. Gaza strip is a good example for such areas with agriculture representing a backbone for population life. In this regard, this study focused on using fungi isolated from the environment as a partial or complete alternative for chemical fertilizers. It may aid in reducing the consumption of these fertilizers and thus minimize the environmental and health burden on human life. This study is the first to tackle this issue in Gaza strip. Among the specific objectives of this study was the use of fungi isolated from the same natural soil of the agricultural areas. In this regard question may be raised about the benefit of this study especially that these fungi are coexisting side by side with the plants in the field, the answer to this is by highlighting the destructive effect of the intensively used chemical fertilizers on the symbiotic fungi that prevents the fungi from reaching the roots of the plants (Miranda *et al.,* 1989, Bougher *et al.,* 1990) [12, 3]. The intensive use of chemical fertilizers thus make the growing plants live independently from symbiotic fungi. According, this study will be of great benefit in establishing a role of mycorrhizal fungi in encouraging plant growth with similar efficiency as chemical fertilizers. The results of our study will encourage decision makers to adopt strategies for isolating, growing and using mycorrhization as an efficient alternative for chemical fertilizers.

Use of fungus spores suspension

The outcomes of this study showed that endomycorrhization plays clear role in positively impacting on shoot and root growth when a fungus spores suspension injected. A greater growth was always evident in the presence of fungi in all forms in comparison with control plants.

Summer squash plants

The results of the study showed that growth of roots and shoots is increased in the presence of fungus spores suspension when compared to the control plants. Moreover, the roots growth was significantly higher in fungus spores suspension than chemically treated plants (P value = 0.000). These results is in concordance with most similar previous studies (Tisserant *et al.,* 1991; Berta *et al.,* 1995; Dalpe, 2005 and Porras-Soriano *et al.*, 2009) [20, 2, 6, 15].

The presence of fungi in roots of the plant works an increasing their growth especially in the case of endomycorrhization as it causes the roots to enlarge in order to accommodate the fungal mycelia accumulating inside. In the case of shoots growth the effect of mycorrhization was significant in stimulating the growth compared with the control growth but not the chemically fertilized plants, which showed greater growth than all groups. This may be explained by the short study period that did not allow for establishing a clear positive role of mycorrhization on shoots like in the case of fertilizers. The effect of mycorrhization needs longer time to be visible in the case of shoots than roots.

Watermelon plants

Like in summer squash plants, the result of the study showed a better growth in both shoots and roots in the fungus spores suspension injected plants than control plants. Although not statically significant, the growth of watermelon plants with chemical fertilizers was better than with fungus spores suspension injection. This may be explained by the fact that the fungi used in this case were isolated from summer squash seedlings and therefore they may be already specialized.

It may be argued that fungi isolated from summer squash must not symbiotically influence watermelon plants (Van der Heijden *et al.,* 1998) [21]. This is true in the field where the number and infiltration of mycorrhizal fungi is low, and chemical fertilizers are extensively used. However, in our case, we isolated and concentrated the fungi from summer squash roots and injected them next to the watermelon roots (*in vitro* mycorrhization) Van der Heijden *et al.,* 1998 [21].

Use of fungus mycelia directly

When the fungus was directly used by sticking the fungal mycelia to the roots in the presence of agar growth media the results came as follows.

The chemically fertilized plants showed significantly better growth in all cases than plants directly treated with fungal mycelia. The explanation for this relatively lower growth comes from the details of experimental procedure. In this study the agar with the growing fungal mycelia were cut into small cubes which intern were placed next to the plant root therefore we can claim that the fungus would preferentially grow on the agar cubes remains rather than symbiosis with the plant roots. This may be responsible for the weak influence on the shoot and root growth compared the chemical fertilizers.

The comparison between the growth of the plants directly treated with fungal mycelia and control plants showed an advantage of the control plants.

In the case of watermelon plants, the fungal treatment gave slightly better growth than the control but with no statistical significance. In these cases, a competition between the growing plant and fungal mycelia for the limited amount of nutrients in the pots may be responsible for this unexpected result. This is supported by the notably increased growth of the fungus in the pots. The result obtained in summer squash plants similar of these of watermelon plants therefore we may explain the decrease in root growth in fungal treated plants similarly. We found a better roots growth in control plants than in direct treatment supporting the explanation of fungal takeover of organic matter and nutrients in the soil, which resulted in weaker plant growth in general and in roots in particular.

Conclusions

The present study investigated the influence of some fungi isolated from local soil on the growth of two seasonal plants, which are watermelon and squash.

For the determining, the effect of fungus on plant growth, we adopted to compere the plants inoculated with fungi and plants treated with chemical fertilizer, as well as the control plants. On the other hand, we measured the effect of two different method of inoculation of fungus on the plant growth, the mycelium and the spore suspension. The information's that can be conclude from this study are:

- We obtained a net increasing of roots growth and shoots in the presence of fungus spores suspension when compared to the control plants.
- The roots growth of the summer squash plants was significantly better in fungus spores suspension than chemically treated plants**.** In the case of shoots growth, the chemically fertilized plants are better than plants but the results of both fungus suspension and chemical fertilizer is not statistically different.
- In watermelon plants, the result of the study showed a better growth in both shoots and roots in the fungus spores suspension injected plants than control plants**.** Although the growth of watermelon plants with chemical fertilizers was better than with fungus spores suspension injection but without any statistical significance.
- The chemically fertilized plants showed significantly better growth in all cases than plants directly treated with fungal mycelia.
- The comparison between the growth of the plants directly treated with fungal mycelia and control plants showed an advantage of the control plants. This confirm that in case of use of fungus as fertilizer it is very important to treat with the spore suspension.
- In the case of watermelon plants, the fungal treatment gave slightly better growth than the control but with no statistical significance.

In conclusion, we can confirm that the use of fungus spore suspension can be a solution for the fertilization of plants. The study show a very relatively similar result without any statistical significance concerning the plants treated with a specific chemical fertilizer and with fungus spore suspension.

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The Palestinian Ministry of Health report (PMOH 2016).

Annex

Components of chemical fertilizer used in this study (Shifah)

Compound	**Concentration (part per million)**
Phosphorus	330 ppm
Nitrogen	1500 ppm
Zinc	14 ppm
Potassium	3500 ppm
Calcium	165 ppm
Magnesium	238 ppm
Iron	1430 ppm.