EFFECT OF MYCORRHIZA FUNGI SPREAD IN SOIL AND PALM ROOTS ON PHOSPHORUS AND POTASSIUM CONTENT OF THREE LOCATION IN BAGHDAD CITY

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Abstract
A field survey was conducted for three areas in Baghdad city, including Al-Rabaa, Zafaraniya and Rashidya, for the period of January to June to determine the spread of mycorrhiza fungi in the roots of plant trees planted tissue for two types of Al-Zamiliy and Al-Barhi palms trees. The results showed a different incidence of mycorrhiza infection, as the effect of the variety and location affected the intensity of the mycorrhizal colonies in the root system. As the variety significantly affected the number of dendritants in the root system, the location also had the same significant effect. Samples were also collected from the soil surrounding the affected roots and calculating the content of ready phosphorus and extractable potassium. The results showed that intentionally, there were significant differences in the content of ready-made phosphorus in the soil due to the effect of the variety, where Al-Rabaa location gave the highest rate 12.79 mg/kg. It was also found that the two-way overlap between the item and the location caused a significant increase in the percentage of phosphorus content. The results of the extractable potassium content also showed that the potassium level was affected by the variety and location, as the soil cultivated with the variety Barhi gave a higher profit rate of 253.96 mg/kg. Al-Zafaraniya soil recorded the highest content of 285.11 mg/kg. As for the interface between the variety and the location, we notice the superiority of the cultivated soil in which the variety is Zamili in the Rashidiya location, as it gave a content of 381.57 mg/kg.

Key words: mycorrhiza fungi, palm trees, soil, potassium, phosphorus.

Introduction
The term mycorrhiza was first coined by the German scientist Frank in 1885, the origin of the name in Greek consists of two parts “Myco” and means mushroom and “rhiza” means root. Most plant have co-existing relationships with mycorrhiza fungi, which promote plant growth by providing nutrients (Frew, 2019). Micro-organisms found in the soil, such as mycorrhiza, are a major link between plant and soil and existing mineral nutrients, so there is growing interest in using them as biofertilizers and mycorrhiza are coexistence organisms that are compulsory coexistence belong to phylum Glymeromycota (Schübler et al., 2001).

Many source have indicated that mycorrhiza helps absorb major nutrient such as phosphorus when the level of the ingredient is low in the food media (Sylvia et al., 2001). The mycorrhiza is not only equipped with phosphorus in soil, which suffers from the lack of this element, but it has other benefits where it can absorb other elements such as nitrogen, calcium, potassium, sulfur, manganese, iron, zinc and copper and these elements are transmitted through roots to plant and from the important effects are the absorption of non-moving elements such as zinc, phosphorus and copper (Von, 2007 and Utobo et al., 2011).

The settlement of the mycorrhiza under the bad conditions of some unfertile soil or in dry or satly soils helps to reduce the requirements of plants for phosphorus and other elements and this has a good effect on plants by increasing the absorption of phosphorus and other elements whether ready or not ready and that the use of biofertilizer helps to reduce chemical additives and this increase control over safe food production (Rajaram et al., 2014).

Therefore, the present study aimed to measure the effect of mycorrhizal fungi in the soil of palm trees on
the content of phosphorous and potassium elements therein.

**Materials and Methods**

**Materials**

KOH (10%) (India, CDH), NH$_4$OH, Hydrogen peroxide (UK, BDH) (to prepare alkaline peroxide solution), Lactic acid and Glycerine, Fuchsin stain (India, CDH) (to prepare acidic Fuchsin).

**Samples collection**

Samples of palm roots were collected with samples of the soil surrounding the roots and a distance of 30 cm and depth of 30 cm from three locations of the city of Baghdad, namely Al-Raba'a station, Al-Zafaraniya and Al-Rashidya of the Ministry of Agriculture and by three repeats for each palm and placed in nylon bags for use (Alwan et al., 2010).

**Isolation and staining the roots**

After drying the soil by air the roots were isolated and stained with the acidic fuchsin dye to ensure that the roots were infected with only mycorrhiza according to (Kormanik et al., 1980). The root samples were placed on a glass slide and examined under a light microscope for the purpose of recording microscopic settlement, of the mycorrhiza, the density of the colonies and the abundance of dendritants. Data were entered into the Excel system to calculate the settlement percentage and according to the following equations (Trouvelot et al., 1986).

1. The percentage of mycorrizal infection in the root system (Murphy et al., 1962).

\[
\text{Percentage of frequency (P\%)} = \frac{\text{Number of radical pieces infected with mycorrhiza}}{\text{Total number of root pieces}} \times 100
\]

2. The density of the mycorrhiza colonies in the radical system (M%)

\[
M\% = \frac{n_1 + 5n_2 + 30n_3 + 70n_4 + 95n_5}{\text{Total number of roots pieces}}
\]

3. The density of the mycorrhizal colonies in the root pieces (m%)

\[
M\% \times \frac{\text{Total number of roots pieces}}{\text{The number of mycorrhiza pieces}}
\]

4. Number of dendritants in the mycorrhizal parts to root pieces (a%)

\[
10 \times a = \frac{10 \times 41 + 50 \times 42 + 100 \times 43}{100}
\]

5. The dendritants provided in the root system A% = \(a\% \times \frac{M\%}{100}\)

Check the content of the soil of ready phosphorus and recoverable potassium and complement the following:

1. Measuring ready phosphorous according to its method (Murphy et al., 1962).

2. Measuring the recoverable potassium content according to its method (Page et al., 1982).

**Results and Discussion**

**Percentage of frequency**

The results shown in table 1, showed that there were no significant differences in the percentage of frequency due to the effect of the variety, we also notice from the results of the table a significant superiority of site impact. Al-Raba'a site gave the highest frequency of 95.83%, then Al-Zafaraniya followed with frequency of 81.48%, while Al-Rashidya site gave the lowest frequency ratio with the lowest frequency of 78.6%. It was also found that the bilateral interference between the variety and the site caused a significant increase to the percentage of the frequency. The Zamili varites in the Al-Raba'a site gave the highest rate 100%, while Barhi gave in the lowest percentage of Al-Rashidia site reaching 62.96%.

**Density of the mycorrhiza colonies in the radical system**

It is noted from table 2, that the density of colonies, the mycorrhiza colonies in the root system was affected by the variety, as the Zamili variety gave the highest density of 44.02% while the variety Barhi was given the lowest percentage of 27.20%, while the results were noted, the density of the mycorrhiza colonies in the root system at the site was affected, giving Al-Raba'a site a high of 64.34%, then followed by a significant difference of the location of Al-Zafaraniya with a rate of 35.70%, compared to the Rhashidiya site, which gave the lowest rate of 17.68% variety. As for the effect of the overlap between the site. The results of table 2, show the superiority of the Zamili variety at the Al-Raba'a site by giving it the highest percentage of the density of the

**Table 1: Effect of the variety, location and the interference between them in the percentage of frequency.**

<table>
<thead>
<tr>
<th>Variety rate</th>
<th>Location</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Al-Rashidiya</td>
<td>Al-Zafaraniya</td>
</tr>
<tr>
<td>81.17 a</td>
<td>62.96 b</td>
<td>88.89 ab</td>
</tr>
<tr>
<td>89.61 a</td>
<td>94.75 ab</td>
<td>74.07 ab</td>
</tr>
<tr>
<td>78.86 b</td>
<td>81.48 b</td>
<td>95.83 a</td>
</tr>
</tbody>
</table>

*The averages of each group followed by letters indicate the presence of significant differences between them at probability level 0.05 according to the Duncan polynomial test.*
Table 2: The effect of the variety, location and overlap between them on the density of mycorrhiza colonies in the root system.

<table>
<thead>
<tr>
<th>Variety rate</th>
<th>Location</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Al-Rashidiya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Zafaraniya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Raba'a</td>
<td></td>
</tr>
<tr>
<td>34.46 b</td>
<td>29.1 bc</td>
<td>Barhi</td>
</tr>
<tr>
<td>44.02 a</td>
<td>42.10 b</td>
<td>Zamili</td>
</tr>
<tr>
<td></td>
<td>17.68 b</td>
<td>Location rate</td>
</tr>
</tbody>
</table>

*The averages of each group followed by letters indicate the presence of significant differences between them at probability level 0.05 according to the Duncan polynomial test.

Density of mycorrhiza colonies in pieces of roots

The results of table 3, indicated that the variety significantly affected the density of the colonies of mycorrhiza in pieces of root as it reached 45.67% in the Zamili variety, while the density of the colonies in the pieces of roots was 37.78% in the Barhi variety.

As for the influence of the location on this trait, it was found that the Al-Raba'a site had the highest ratio of 64.59% and then followed it with a significant difference of the Rashidiya site, as it gave 41.76% and the Zafaraniya site gave the lowest percentage of the density of the colonies in the pieces of roots at 18.81%.

With regard to the overlap between the variety and the location the results of table 3, are noted above the Zamili variety at the Al-Raba'a location as it gave the highest density of the colonies of mycorrhiza in the pieces of the roots, while the same item gave the lowest percentage in the location of Zafaraniya a ratio of 12.08%.

Table 3: The effect of the variety and location and overlap between them in the density of mycorrhiza colonies in the pieces of the roots.

<table>
<thead>
<tr>
<th>Variety rate</th>
<th>Location</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Al-Rashidiya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Zafaraniya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Raba'a</td>
<td></td>
</tr>
<tr>
<td>37.78 b</td>
<td>38.89 bc</td>
<td>Barhi</td>
</tr>
<tr>
<td>75.67 a</td>
<td>44.65 bc</td>
<td>Zamili</td>
</tr>
<tr>
<td></td>
<td>41.76 b</td>
<td>Location rate</td>
</tr>
</tbody>
</table>

*The averages of each group followed by letters indicate the presence of significant differences between them at probability level 0.05 according to the Duncan polynomial test.

Table 4: The effect of the variety and location and overlap between them on the number of dentritants in the root system.

<table>
<thead>
<tr>
<th>Variety rate</th>
<th>Location</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Al-Rashidiya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Zafaraniya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Raba'a</td>
<td></td>
</tr>
<tr>
<td>2.97 a</td>
<td>1.31 b</td>
<td>Barhi</td>
</tr>
<tr>
<td>2.53 b</td>
<td>0.72 c</td>
<td>Zamili</td>
</tr>
<tr>
<td></td>
<td>1.0 b</td>
<td>Location rate</td>
</tr>
</tbody>
</table>

*The averages of each group followed by letters indicate the presence of significant differences between them at probability level 0.05 according to the Duncan polynomial test.

dentritant 2.47%, while the Zamili variety gave the lowest average number of dentritant to 2.53% dentritent.

As for the number of dentritants in the root system, the sites influence increased as the Al-Raba'a location gave the highest rate of dentritants at 7.16% dentritant, then followed by a significant difference in Rashidiya location as it gave a number of dentritants of 1.01% dentritant. While Al-Zafaraniya location gave the lowest average number of dentritants in the root system of 0.08% dentritant, which did not differ significantly with the Rashidiya location. As for the effect of interference between the variety and the location, it is noticed from the results of table 4, the superiority of the Barhi and Zamili variety in the Al-Raba'a location by giving them the highest average number of dentritants in the root system, reached 7.52, 6.81 dentritant respectively. While the Zamili variety in the Zafaraniya location gave the lowest rate of 0.07 dentritant.

Torrey, 1976 stated that a biological agent that has on the formation of spores, which is the change in the production of substances resulting from plant photosynthesis, as well as other factors such as the quantity and type of root secretious (Jakobsdon and Nielsen, 1983) and levels of root hormones (Gemina and Koske, 1989).

Studies have indicated that there is a positive relationship between the number of spores and the potassium.

Table 5: The effect of the variety, location and overlap between them in the content of the extractable potassium.

<table>
<thead>
<tr>
<th>Variety rate</th>
<th>Location</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Al-Rashidiya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Zafaraniya</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al-Raba'a</td>
<td></td>
</tr>
<tr>
<td>253.96 a</td>
<td>155.61 bc</td>
<td>Barhi</td>
</tr>
<tr>
<td>193.06 b</td>
<td>381.57 c</td>
<td>Zamili</td>
</tr>
<tr>
<td></td>
<td>147.09 b</td>
<td>Location rate</td>
</tr>
</tbody>
</table>

*The averages of each group followed by letters indicate the presence of significant differences between them at probability level 0.05 according to the Duncan polynomial test.
percentage of mycorrhiza infection due to the size of the increase in fungal colony. The layer the size, the higher the incidence and at the same time it is reflected in the composition of the spores, so the reason for the difference in the number of spores by different months and the host plant can be attributed to the different percentage of injection (Koske and Halvorson, 1981 and Anderson et al., 1984).

The reason for the increase in the number of spores for biofertilizer is the effective role of mycorrhiza fungi and their ability to coexist and grow in the largest area of plant roots and increase the percentage of mycorrhiza infection to the roots in accordance with (Al-Fahdawi, 2016).

**Effect of the variety, location and overlap between them in the content of the extractable potassium**

Table 5, show that the extractable potassium content was affected by the variety, as the cultivated soil of the variety Barhi gave the highest percentage of potassium content in 253.96 while the cultivated soil gave the Zamili variety the lowest percentage of potassium content of 193.06.

As for the effect of the location on potassium content it was found that there were significant differences, as the top soil Al-Zafaraniya reached the highest content 285.11, followed by Al-Rabaa location, which gave a content of 238.33, while the Rashidiya location gave the lowest content of potassium, reaching 147.09.

As for the interference between the variety and the location it is noted from the results of table 5, that the higher content of the cultivated soil in the Zamili variety of potassium at the Rashidiya location was given the highest extractable the potassium content of 381.57 while the variety Barhi was given with a profit in the Rashidiya location with a content of 238.33, while the Barhi variety in Rashidiya location gave the highest percentage of potassium content of 6.41, while the Al-Rabaa location gave the highest percentage of potassium content of 12.79.

The reason for the increase in ready potassium is due to the excretion of oxalate on the surface of the roots that contain mycorrhizal fungi and under conditions of potassium deficiency and replaces potassium in the clay minerals layer and this lead to a biological weathering of the minerals because the mycorrhizal fungi have the ability to dissolve mineral compounds through acid analysis such as the secretion of organic acids such as oxalic acid, citric acid, nutrients, reductions and oxidation (Salman, 2011) and this confirmed by (Al-Khaliel, 2010) and (Khan and Zaidi, 2007).

**Effect of the variety, location and their interaction on phosphorous content in the soil**

The results showed in table 6, that were no significant differences in the content of phosphorus ready in the soil, as a result of the effect of the variety we also notice from the results of the table a significant superiority due to the impact of the location on the content of ready-made phosphorus.

Al-Rabaa location gave the highest percentage of phosphorous content of 12.79 followed by the Al-Zafaraniya location with a content of 6.41, while the Rashidiya location gave the lowest percentage of phosphorous content of 3.79.

It was also found that the interaction of the due between the variety and location caused a significant increase to the percentage of phosphorous content. The variety Zamili in the Al-Rabaa location gave the highest rate of 13.02, while the variety Bahri in Rashidiya location gave lowest rate of 3.36.

The reason of increasing of concentration of phosphorous is due to the ability of mycorrhiza to absorb phosphorous present in the soil in an incomplete manner by extending the fungal hypha to far distances from the roots and the secretion of some organic materials that can dissolve complex compounds and this leads to increased phosphorous in the soil. The fungus of mycorrhiza secrets the enzyme of phosphatase, which is found in the hypha and vesicles and this helps to dissolve phosphorous from different sources and increases the readiness for the plant and this corresponds to what is said (Khan and Zaidi, 2007 and Rahman et al., 2010).

**References**


