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INTERACTION INDICATORS BETWEEN PLANT AND ENVIRONMENT DATE PALM (*PHOENIX DACTYLIFERA*) AS AN EXAMPLE

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Abstract:
Ecosystem is a branch of biology concerning a study the interaction between living organisms and the environment where they live. Each plant community has a special range of eco-conditions that could be wide or narrow depending on biotic, and abiotic factors. Date palm *phoenix dactylifera* is the most important palm species in Arecaceae family and is the most popular and historic fruit tree in Iraq and Arabic gulf area, it's considered the best example of the interaction between environment and plant. Over years, *phoenix dactylifera* modified some phenotypical and anatomical features in leaves as one of a response form for environmental stress such as length and width of leaflets as well as cuticle and epidermis layers. These modifications have an important role in the tree adaption to environmental stress such as drought, salinity and high temperature. Also, one of plant methods to stress resistance is a synthesis of effectible molecules that help in adaptation mechanism of grown plants under stress conditions Thus, study the protein pattern of pollen of *phoenix dactylifera* that are grown in different environments show significant differences in the number, frequency and molecular weight of protein bands in the pollen grains. The current review displayed how a wide response of date palm tree to environmental changes characterized robustly the interaction between plants and the environment in nature.

Keywords: Phoenix Dactylifera, Environment, Interaction, Biotic And Abiotic Stress, Adaptation.

BASIC ECOLOGICAL UNDERSTANDABLE

Ecosystem is the science that study the interrelationship between living organisms and factors of the environment where they live. These factors include physical factors such as soil and weather as well as organic factors such as food abundance and organic compounds in the soil. In addition to biological factors that are related to the plants, animals, and micrograms and their interaction with the environment.

Ecology fields in biological studies can be determined by the biological spectrum that include different levels of biological studies and can be classified to:-

1- Molecular Biology: study on the level of molecules and organic biological compounds
2- Cytology: study on the level of structure, Ingredients and function of cells as well as the relation between structure and function. It's known now a cell biology.
3- Physiology and Histology: study on the level of structure and function of tissues and organs of the organism body.
4- Autecology: study on the level of individual and his relation with different environmental factors in soil and weather.
5- Population Ecology: study on the level of a group of individuals belong to the same or close species
6- Synecology: study on the level of mutual relationships between organisms are living in the same environment.
7- Ecosystem or Ecological system: study on all factors that control organisms presences and distribution in the environment.
8- Biosphere: Study the regions on the surface and atmosphere of the earth where organisms live Figure (1). (Bader, 2007).

Parts of Ecology.

Ecologic studies can be classified to:

1- Species Ecology or Autecology
2- Population Ecology
3- Community Ecology

4- Ecosystem Ecology
5- Biosphere Ecology
These five parts have effects on plants and are affected by plants in a negative or positive way special with a human activity (Chazanfar and Edmondson, 2013).

THE PLANT ENVIRONMENT

It can be defined as the conditions of area where individual plant or group of plants live. When environment is studied, it's so necessary to distinguish between the general environment for group of plants and the environment for each plant that belong to the same group. For instance, environment conditions that are required for tree growth are different than conditions for pteridophyta that is growing on a cortex of this tree. However, both of plants are living in the same general environment and share some growth conditions such as a weather. Each community of plants has a particular range of environmental conditions where they can be lived. This range can be wide or not according to many factors. For example, there are some plants species can be survival in area that has special environmental conditions. However, the presence of these plants species is not limited in that area. All plant species as all the organisms work permanently to expand their environment range according to how long a time they can be survival in the area. (Alsaadi, 2009)
The spread of particular plant species which mean expand their environment range may be determined by many agents such as the presence of ocean, mountains, and deserts or adjacent plant species. However, when some plants transferred from their own habitats to other, they have ability to adaption and rapid growth. Also, they produce numerous and easy spreadable seeds in a short time. (El-hasseiny, 2005).
The knowledge of ecological factors is so crucial to know the plants' nature. Thus, study the structure and distribution of plants gatherings require the investigation of chemical and physical properties of the environment which assists the researchers to understand the interaction forms between plants and their environment. (Almiyah et al., 2016). Ecological factors can be classified into four main parts (Figure 2).

DATE PALM (*PHOENIX DACTYLIFERA*) AND THE ENVIRONMENT

Date palm is the most important palm species in Arecaceae family that includes more than 200 genus and 2500 species and considered the most plant family beneficial for human after Poaceae family (El-Hadrami, 2009; Jain et al, 2011). *phoenix dactylifera* is a one of trees that has ability to adapt to environmental stress such as high temperature, drought and salinity (Govarets and Dransfield, 2005). However, these hard-environmental conditions affect widely on dates yield as the result of plant and environment interaction. The phenotypical, anatomical, biochemical, and biological alterations can be used as indicators to identify the type of interaction between plant and environment.
The interaction between plant and its environment (developing process) caused unstable status for the plant. However, Plant Taxonomy aims to create a comprehensive classification for different world plants and present the relation between them. Thus, specialists in plant Taxonomy hired botany branches such as Anatomy, Palynology, and Histology etc.. to this goal.
Salt stress is the most stress form that influence plant growth and lead to water stress due to reduction in water absorption. The majority of stress forms cause a lack in proteins modification and amino acids synthesis in plant tissues (Popp, 1990). Challa and his colleague reported that the mechanism of environmental stress on plants is represented by numerous of structural, anatomical and morphological changes in plants (Challa and Van, 2004). In date palm trees, vegetative phenotypic traits are utilized in the identification of classification levels including family, genus, and species. General shape features of palm trees are used to distinguish between palm trees species (Soliman, 2006). Gondara and his colleagues found when they studied a group of *phoenix dactylifera* trees, there were differences in the length, width, color and flowers number of spathes of trees were grown in the north of India compared to trees grown in south (Gondara et al., 1994). Also, Jaradat and Zaid identified the relation between date palm species in gulf countries by using the cluster analysis, they found UAE date palm trees are separated in one group from the rest of species in gulf countries, the cultivars in Bahrain and Oman are so related compared to other Arabic cultivars. The determined variations that are in phenotypic traits between the cultivars were due to the environmental differences where the trees grew (Jaradat and Zaid, 2004). Similarly, numerous of male *phoenix dactylifera* cultivars that are grown in different regions in Iraq have been studied, Alnajjar found that environmental conditions had effectible role on phenotypic characteristics of leaves and flowers. Leaves showed significant differences in length, number of leaflets, and spines distribution as well as significant differences in length, width and blooming date of inflorescences. The majority of *phoenix dactylifera* trees in Iraq are reproduced by vegetative propagation. However, the differences in phenotypic traits of leaves and flowers that found by the investigator were due to plant adaption to environment which lead to many morphologic changes in the leaves and inflorescences of the trees. (Alnajjar, 2014).
Pollen morphology is utilized to identify and determine the species of plant families by study of pollen grains structure. The invention and developing of Scanning Electron Microscope (SEM) facilitated widely the study of comparative morphology of pollen grains and then it can be used as an auxiliary feature in the taxonomy. For instance, in date palm, pollen grains that have groove germination hole are less developed than pollen grains that have circle germination hole (Alwhaib, 2011). Also, Alnajjar reported in his study that pollen grains from different cultivars of male date palm have oval to elliptical shape and the highest average of length and width of pollen grain were 26 and 12.88 µ respectively (Alnajjar, 2014), (Figure 3).

The biotic and abiotic factors determined the abundance and distribution of plants, especially in desert regions. However, plants adapt continuously by developing of morphological and anatomical properties which enable them to stay a survival (Wahid, 2003). Almeer and Tariq studied the adaptation probability of *phoenix dactylifera* from tissue culture for hard eco conditions, they found increasing in chlorophyll synthesis, cuticle and wax layer as well as decreasing in the number of stomata as one of interaction form between plant and environment (Almeer and Tariq, 2014). These phenotypical alterations play important role to reduce water loosing under desert conditions. (Wahid, 2007; Dickison, 2000).

In the comparative study by Alapresam and her colleagues for some morphological and anatomical traits of two desirable Iraqi cultivars, Barhy and Halawy that are grown in two environments, desert regions and Shat Alarab orchards. She found date palm trees that are grown in Shat Alarab orchards exceeded in trunk dimeter, leaf length, leaflet length, leaflets number, rachis thick, and length and width mesophyll layer compared to trees that are grown in desert regions which exceeded in spines number and cuticle and epidermis layers thick (Alapresam et al., 2012); (Table 1,2); (Figure 4). In similar, Alnajjar found that environment conditions had effectible role in leaves anatomical traits of different cultivars of *phoenix dactylifera* trees in Iraq including upper and lower epidermis. Also, he found the cultivars differed in anatomical features of big vascular bundles which include metaxylem, protoxylem, phloem, cambium cells, epidermis, cuticle, vascular sheath (Alnajjar, 2014); (Figure 5). The growing of plant in the desert environment cause numerous of phenotypical and anatomical changes including decrease leaf's blade and spongy mesophyll which lead to decrease the leaf area index and increase cuticle and epidermis layers thick. The thickness of epidermis and cuticle helps date palm trees to grow in desert regions due to reduction in water and gases loss (Abulfatih, 2003, Soliman and Khedr, 1997; Soliman, 2006). Also, the lack of water in the desert environment decrease the number of leaves and reduce a turgor pressure that cause reduction in a surface area of leaves (Hsiao, 1973, Djibril et al, 2005).

One of plant methods to stress resistance is synthesis of effectible molecules that help in adaptation mechanism of grown plants under stress conditions. These molecules are proteins and metabolites that have important function in the regulation of biological processes as responding to the stress (Alnajjar et al., 2011). Alassi found differences in protein bands patterns of three cultivars of *phoenix dactylifera* trees khalas, sheshi, and Rezez that are grown in Saudi Arabia (Alassi, 2006). In the comparative study between palm trees that reproduced by tissue culture or regular method (offshoots) for four cultivars of date palm in Saudi Arabia, Alquraini found there were differences between the two reproduction method in types, number, density, and thick of proteins bands that relayed on the gel after exposure to different types of stress (Alquraini et al, 2006). At the same context, Anajjar has reported that protein pattern of male palm trees recorded differences between the cultivars in number, frequency and molecular weight of protein bands on SDS polyacrylamide gel (Alnajjar, 2014) (Figure 6). By utilization of ISSR markers (AG10G ,AGG6, 814 , 844A , BT_5 , BT10) to find the DNA fingerprinting and genetic diversity of 24 cultivars of date palm that are grown in different regions in Iraq, Alghezi found that ISSR markers gave bands that were different in the number and frequency on agarose gel, AG10G showed the highest bands number and genetic diversity between date palm cultivars as a kind of responding to the location (Alghezi, 2015) (Figure 7).

In the study that have been done by Alnajjar to investigation the link between eco stress and proteins pattern for numerous of date palm trees of Halawi and Sayer cultivars under various stress conditions , he found differences in the number and frequency of protein bands according to stress conditions and cultivars. The different stresses had obvious effect in molecular weight and frequency changes of protein bands as it illustrated in table 3

Phoenix Dactylifera Is The Environment's Friend Tree

Due to some distinctive features, *phoenix dactylifera* is considered an integrated source of food and non-food products. In addition to the high nutritional value of dates, date palm tree gives non-food products that can be utilized for furniture and kitchen tools making (Ibrahim 1, 2014) Below some of these features: -

1- Leaves

In the normal conditions, after 6 years of leaf age, leaf loose chlorophyll pigment and dry. Due to the absence of the abscission zone, leaf keep its adhesion on trunk which reduce subsequently the grubbiness of surrounding environment. Also, Phenotypic and anatomy of the date palm leaf such reduce widely water loss by stress conditions. Leaflets of palm leaves are thick, surrounded by waxy layer with tiny and gummy stomata (Ibrahim 1, 2014).

2- Leaves and fruits decomposing

Fallen leaves and fruits have benefit to improve soil properties when they are decomposed. Previous study reported that 120 trees of date palm consume huge amount of nutrients that are used in the growth and formation of leaves and fruits. In addition, during tree pruning, tree loos massive quantities of these nutrients. One Palm tree consume approximately 600 gm of phosphor and 225 gm of potassium to obtain 45 Kg of date fruit, while one-hectare of date palms loos yearly 54, 7, and 144 Kg of nitrogen, Phosphor, and Potassium respectively (Ibrahim 2, 2014) (Table 4).

Many of these nutrients return to the soil back when fallen fruits and leaves are decomposed. Table 4 clarify the percentage of NPK in the leaves and leaves bases of date palm after decomposing (Ibrahim 1, 2014) (Table 4)

3- Date palm's role in air purification

Archaeological fees from Mesopotamia showed that date palm trees were cultivated near to a high slot of houses to cleaning, moistening, and purification of air. Leaves act as air filters from dust particles and pollutants which provided fresh air inside the houses. Also, the curtains were made from date palm leaves, moistened by water and utilized as natural air conditioners (Ibrahim 1, 2014).

In the previous study have been done by a group in Saudi Arabia, they investigated a clustered dust amount on the leaves of khalas cultivar according to how far these trees to unpaved agricultural roads, (Qasim et al., 1986). (Table 5). Also, by study the amount of fallen dust on palm leaves during 5 months from May to September in Basra city in Iraq (Almiyah et al. 2014) (table 6), both studies illustrated the important role of palm trees in air purification from pollution by their leaves.

4- Intercropping

Date palm orchards can be used to grow crops, vegetable and fruit trees by exploit of interstitial distances between trees. when date palm reach to 10 years age, trees with bad growth are removed and fruit trees can be cultivated with consideration to regulation of cultivation distances. Date palm trees provide protection from high temperature and dust storm for fruit trees. for example, farmers in Abu Alkhaseb country at Basrah city grow grapes, figs, mango, and pomegranate, while in Shat Alarab and Alder countries at a same city, they prefer to grow grapes and buckthorn trees between date palm trees. Also, some of annual plants such as tomato and cucumber can be planted between date palm trees which utilized to make a good composting post the growth season (Ibrahim 2, 2014).

CONCLUSION

Plants, *phoenix dactylifera* as an example have a high ability to creation numbers of alterations in phenotypic, anatomic and biologic levels that could be utilized to study the interaction between plant and environment. These alterations enabled date palm tree to resistance environmental stress and adaptation on a wide range of eco factors and consequently keeping its role as an environment friend.

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LEGENDS

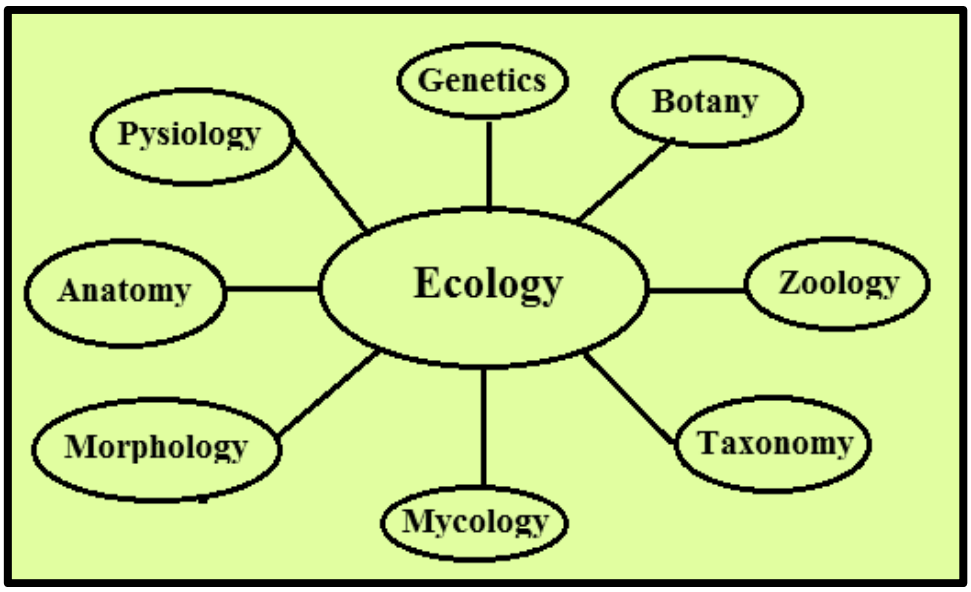

Figure (1): Simple diagram of related sciences to ecology (Bader, 2007).

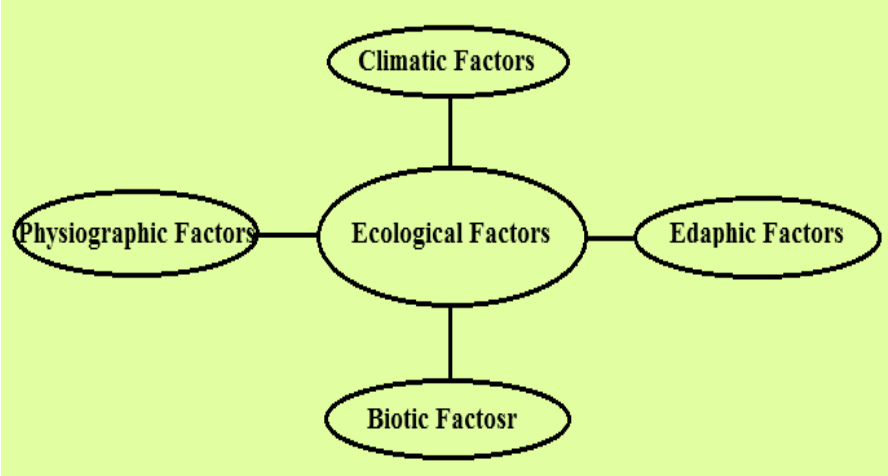

Figure (2): Diagram of classification of ecological factors (Bader, 2007).

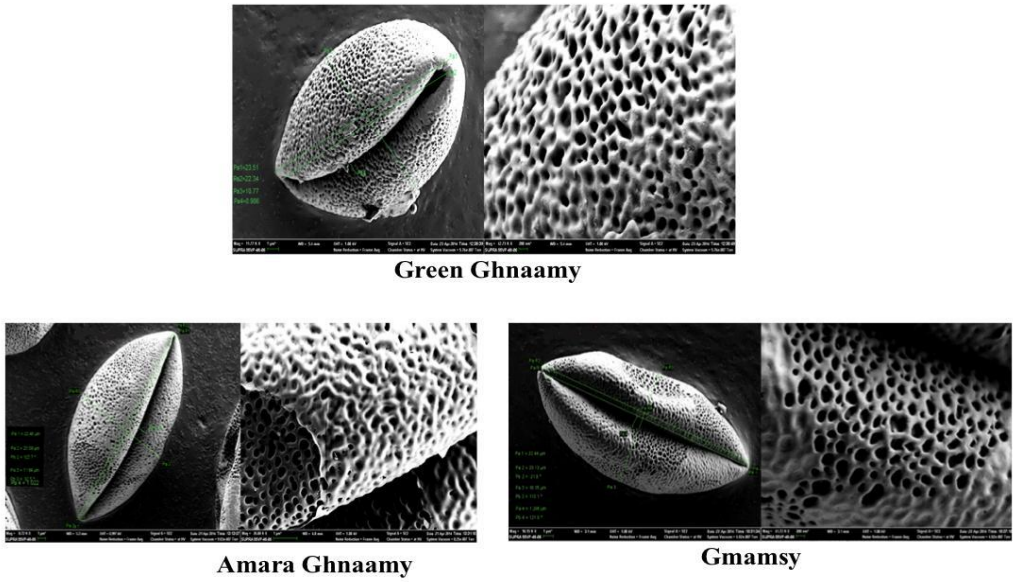

Figure (3): SEM photos of pollen grains of male date palms are grown in the different environments. (Alnajjar, 2014).

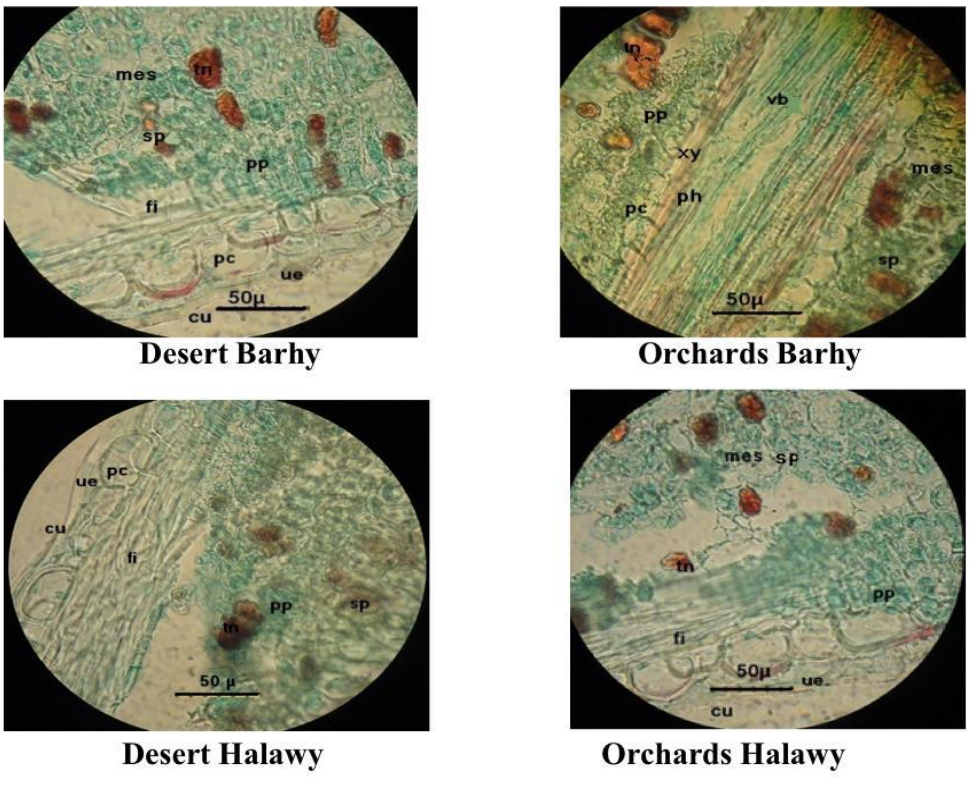

Figure (4): Anatomical differences between leaves of Barahi and Halawi cultivars that are implanted in Shat Alarab orchards and desert regions (100x) (Alapresam et al, 2012).

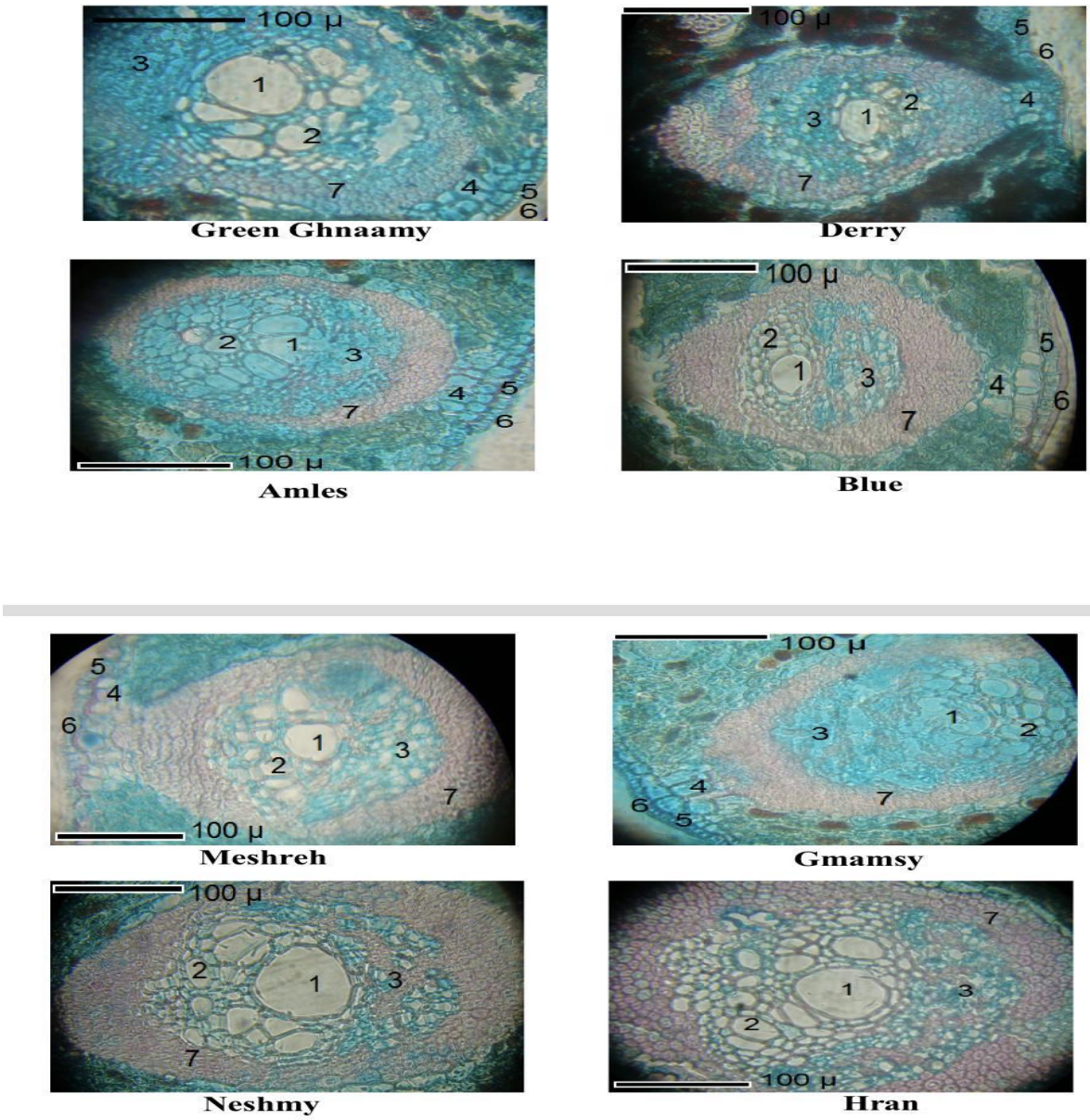

Figure (5): Cross section in leaflets of male species that are grown in different regions in Iraq. Large vascular bundle include (1-Metaxylem, 2-Protoxylem, 3-Phloem 4- Cambium cells, 5-Epidermis, 6-Cuticle 7- Vascular sheath), . 40x (Alnajjar, 2014).

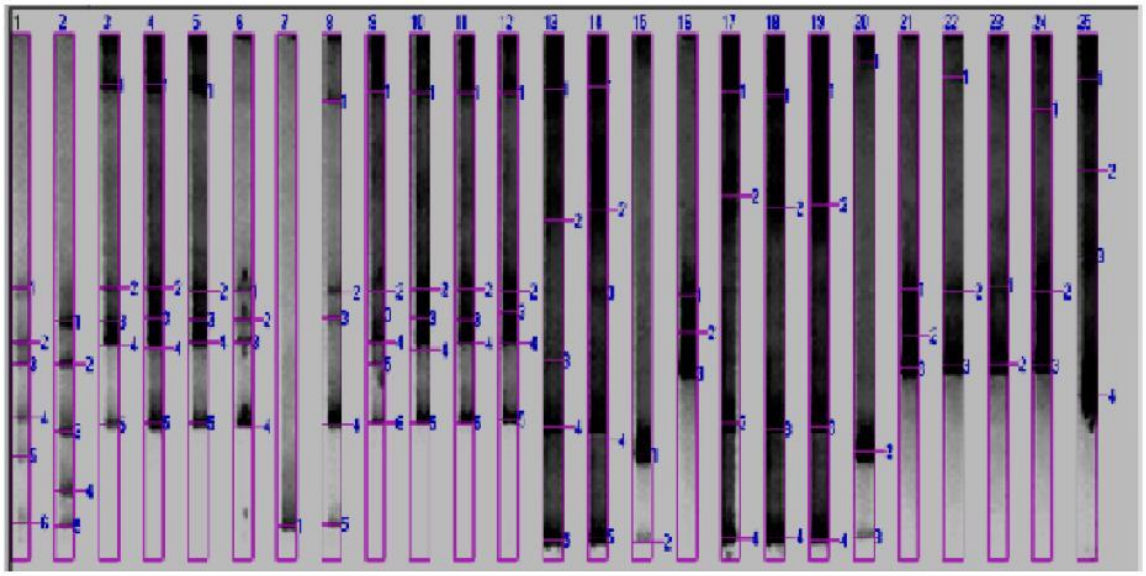

Figure (6): Number and frequency of protein bands by photocapt software for 24 of male date palms tress cultivars that are grown in different locations in Iraq (Alnajjar, 2014).

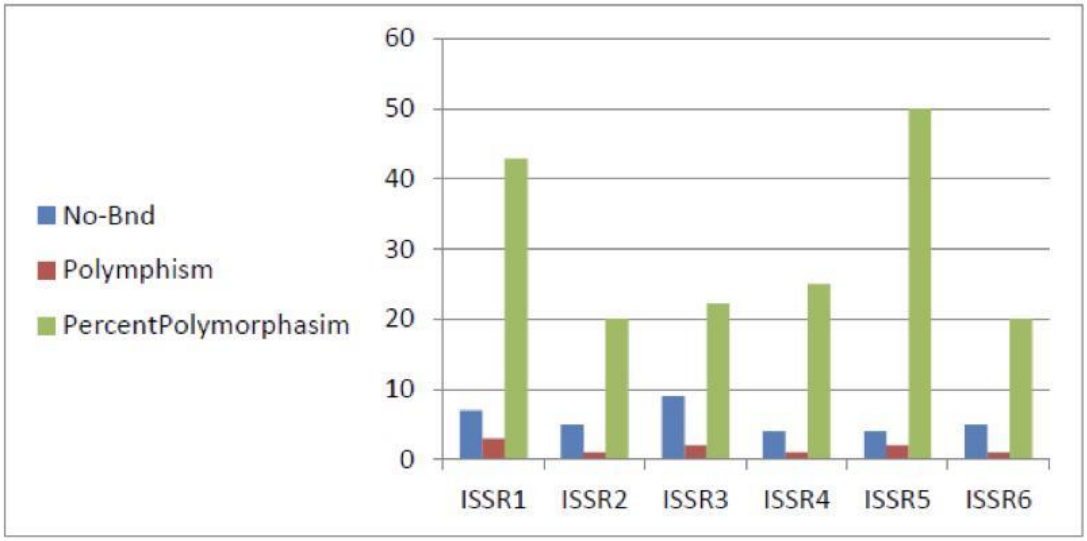

Figure (7): Genetic diversity of ISSR markers for 24 cultivars of date palm (Alghazi, 2015).

Tables

Table (1): Phenotypical and anatomical changes of implanted Barhi cultivar on Shat Alarab orchards and desert regions (Alapresam et al., 2012).

Regions	Studied Traits							
	Trunk dimeter (cm)	Leaf length (cm)	Leaflet length (cm)	Leaflet width (cm)	Leaflets number	Leaf base width	Spines number	Spines length
Desert	169	380.2	52.72	3.80	167.7	26.19	42.19	13.9
Orchards	188.7	416.3	65.70	4.90	186.3	33.7	36.16	11.3

RLSD P≤0.05	5.65	10.05	4.30	1.10	6.54	5.71	3.78	NS

Regions	Studied Traits							
	Rachis thick	Mesophyll thick	Mesophyll cells length	Mesophyll cells width	Epidermis thick	Epidermis cells length	Epidermis cells width	Cuticle thick
Desert	393	347	27.9	7.20	19	26.77	7.90	6
Orchard	547	505	32.94	8.90	10.3	28.83	8.01	3.09
RLSD P≤0.	90.2	93.6	4.76	1.22	NS	NS	0.94	2.78

Table (2): Phenotypical and anatomical changes of implanted Halawi cultivar in Shat Alarab orchards and desert regions (Alapresam et al, 2012).

Regions	Studied Traits							
	Trunk dimeter (cm)	Leaf length (cm)	Leaflet length (cm)	Leaflet width (cm)	Leaflets number	Width of Leaf base (cm)	spines number	Spine length (cm)
Desert	128.7	311.7	38.64	2.86	119.7	19.76	22.67	11.1
Orchards	160	350.5	46.75	3.11	138.5	24.72	16.90	8.4
RLSD P≤0.05	16.13	30.30	4.78	NS	7.01	NS	2.93	2.45

Regions	Studied Traits							
	Rachis thick	Mesophyll thick	Mesophyll cells length	Mesophyll cells width	Epidermis thick	Epidermis cells length	Epidermis cells width	Cuticle thick
Desert	303	283.3	27.4	6.47	8.14	23.2	7.29	5.14
Orchards	400	386.7	31.7	8.02	4.71	31.1	8.62	2.57
RLSD P≤0.05	83.8	35.54	NS	NS	3.36	5.69	NS	2.06

Table (3): Molecular weights of proteins bands in Halawi and Sayer cultivars of date palm (KDa) (Alnajjar, 2017).

Protein Bands	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Markers	254.16	146.68	139.38	133.24	96.42	65.47	19.04
Halawi control	253.12	143.66	132.54	84.52	40.47	16.66	0

Halawi flood stress	252.08	219.10	146.99	144.11	140.22	90.47	0
Halawi saline stress	251.04	219.10	143.66	140.99	133.24	124.01	94.04
Halawi dry stress	252.08	220.08	162.44	146.78	86.90	3.57	0
Sayer control	248.94	217.15	146.78	143.66	140.22	90.47	0
Sayer flood stress	252.08	148.03	146.78	144.51	139.81	91.66	0
Sayer saline stress	251.04	220.08	216.17	146.78	144.69	140.22	94.04
Sayer dry stress	252.08	216.17	146.78	140.62	92.85	0	0

Table (4): The amount of used and lost NPK by date palm. (Ibrahim 2, 2014)

Mineral	Used NPK (kg)	Lost NPK (kg)	Total
N	29	25	54
P	5	2	7
K	70	74	144

Table (5): the percentage of NPK in leaves and leaves bases of date palm. (Ibrahim 1, 2014).

Plant part	N %	P %	K %
Leaves	0.40 – 0.66	0.025- 0.062	0.33- 0.66
Leaves bases	0.28- 0.42	0.017- 0.040	3.46- 4.49

Table (6): clustered dust amount on date palm leaves (Almiyah et al. 2016)

Trees distance from road	Dust amount gm/cm^2		
	1984	1985	Average
10	a0.47	0.78a	0.76a
40	b 0.29	0.33b	0.26b
80	0.23 c	0.19b	0.21b
120	0.12c	0.15c	0.13c