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DETECTING DROUGHT TOLERANCE OF FIG (*FICUS CARICA*, *L*.) CULTIVARS DEPENDING ON VEGETATIVE GROWTH AND PEROXIDASE ACTIVITY

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Abstract

This study was carried out to detect the effect of water stress on vegetative growth and peroxidase activity of two fig cultivars grown in new reclaimed land, in Egypt. In order to simulate drought circumstances, two irrigation regimes were used to treat fig plants (*Ficus carica*, L.) as well as a control treatment, i.e. 100% from class A pan (control), 75% and 50% from class A pan (drought treatments). Plant height, stem diameter, leaves fresh and dry weight and leaf area were measured define the vegetative growth. To quantifying the degree of water status, leaf water content was measured. In addition, free amino acid proline and protein content were measured. Moreover, peroxidase activity and the specific activity of peroxides were determinate in all treatments. Obtained results indicated that the Gizy fig cultivar had the highest vegetative growth compared with Aboudi cultivar under the three irrigation treatments. The peroxidase activities (units/ml) of Gizy cultivar by (100% ETc, 75% ETc and 50% ETc) irrigation treatments were greater than Aboudi cultivars during the two seasons.

Keywords: Drought tolerance, Fig (*Ficus carica*, L.), vegetative growth and peroxidase, peroxidase activity, leaves water content, proline content

1. INTRODUCTION

Egypt lies between latitudes 22° and 32°N, and longitudes 25° and 35°E, with about one million square kilometers of land, under arid and hyper-arid climatic conditions. Egypt location reflected a negative impact on agriculture, water resources and ecosystems (López-Moreno *et al*., 2009). Drought is the most critical environmental stress, which is seriously affects germination, survival, growth and performance of shrubs and trees (Fernández *et al.*, 2006).

Plants express water stress tolerance in many different ways but its extent varies from species to species (Chaitanya *et al.*, 2003). Moreover, various responses to drought stress and wide range of mechanisms from

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morphological to physiological aspects are developed. For example the mechanisms developed by some fruit trees to survive water deficits included reduction in growth rate, stem elongation, leaf expansion, orientation and stomata movements (Jung, 2004). A wide range of plants are able to protect themselves by synthesizing antioxidants such as ascorbate and glutathione and enhancing antioxidative enzymes such as peroxidase. Reactions of plant antioxidant systems upon drought have been intensively investigated for several crop plants (Müller *et al.*, 2006).

Fig (*Ficus carica*, L.) is one of the deciduous fruit trees grow in Egypt. It grows successfully along the North-West coast and most of the orchards depend upon the winter rainfall as a main source for their water requirements. It expanded throughout the centuries, where it was known since the Old Kingdom. Although fig plants are mostly grown under rain fed conditions, studies have shown severe injuries to the plant under prolonged drought stress (Hallac Turk and Aksoy, 2011; Gholami *et al*., 2012; Karimi *et al*., 2012). Drought stress incidence results in massive leaf abscission and reduce fruit yield and its quality (Hallac Turk and Aksoy, 2011).

The illustrated drought circumstances in Egypt, improving drought tolerance in fig is an important economical way to improve its productivity under drought conditions. Fortunately, there is a great genetic diversity in fig, which some of fig varity show drought tolerance and others are not drought tolerance. So, obtaining drought tolerant varieties via screening is essential to introduce drought tolerant fig variety.

There is a relation between drought stress and an antioxidant system. Such relationship has been studied in some plant species. Drought stress induces production of reactive oxygen types such as superoxide, hydrogen peroxide, hydroxyl radicals and singlet oxygen in the leaves of plants (Li *et al*., 1998). This reactive oxygen species may cause oxidative damages to cells and internal organelles such as lipid peroxidation, chlorophyll bleaching, protein oxidation and nucleic acids (Scandalios, 1993). Antioxidant defensive system such as peroxidase and low-molecular antioxidants is an important factor in the tolerance of various plants to environmental stress (Rensburg and Kruger, 1994).

Peroxidases (EC. 1.11.1.7, oxidoreductases), have iron porphyrin ring generally and catalyzes a redox reaction between H_2O_2 as an electron acceptor and many kinds of substrates by means of oxygen liberation from H_2O_2. (Brill, 1996; Bansal and Kanwar, 2013). These enzymes are present in plants, animals, and microorganisms (Bansal and Kanwar, 2013). The enzyme occurs in plants like radish and soybean (Ambreen *et al*., 2000), tomato (Zia *et al*., 2001), potato, turnip, carrot, wheat, pear, apricot, banana and dates (Reed, 1975), strawberry (Jen *et al*., 1980) and horseradish (Rehman *et al.*, 1999). Peroxidase is one of the most studied enzymes due to its widespread commercial applications. The commercial value of the peroxidase enzyme is, however, also an important addition to the economic importance of the plant. Other uses of the enzyme include organic synthesis, biotransformation and the treatment of waste water

Other studies confirmed that the highest enzyme activity caused because of water deficit . This fact agreed with those obtained by Bacelar *et al.* (2007), recorded that guaiacol peroxidase (GPX) activity increased in the drought-stressed leaves of olive trees. Sofo *et al.* (2007) reported that the effect of drought on the activities of ascorbate peroxidase (APX) and catalase (CAT) in olive leaves showed a marked increase.

The objectives of this study were, (1) to describe and compares the diversity observed in two local fig cultivars regarding to drought tolerance, (2) select the tolerant fig cultivar from the two studied cultivars.

2. MATERIALS & METHODS

Current investigation was conducted at Cairo-Alexandria desert road (Emam Mallek village), Al-Nobaria district, Al-Behera governorate, Egypt, during 2011 and 2012 seasons. One hundred and eight plants (one year old) of two fig cultivars, namely Abboudi and Gizy were treated during the study.

To simulate drought circumstances, three irrigation regimes (treatments) were applaied with fig plants under study, 100% ETc, 75% ETc and 50% ETc. Irrigation was applied twice a week beginning from the 1st of July to 31st of October during both seasons (about 120 days).

Data of class A pan (E_{pan}) for the studied location (Al-Nobaria) in mm/day were obtained from agro-meteorological station located in the site.

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The first step was to calculate the potential evapotranspiration which was made according to the following formula (FAO, 1977):

$ET_o = K_p \text{ X } E_{Pan}$ (mm / day)

Where:

ETo = Potential evapotranspiration in mm/day.

Kp (Pan coefficient) = three stage (0.5, 0.75 and1)

E_{Pan} = Pan evaporation in mm/day.

The second step was to obtain values of crop water consumptive use (ETc_{rop}) as follows (FAO, 1977).

$ETc_{rop} = ETo \text{ x } Kc$ mm / day

Where:

ETo = the rate of evapotranspiration from an excessive surface of green cover of uniform height (8 to 15 cm), actively growing, completely shading the ground and did not face shortage in water.

Kc = Crop coefficient between

Step 3 was calculate the water requirements (WR) for each treatment. Calculation was done according to the following equations given by Vermeiren and Jobling (1980) as following:

$$ETc = ETo * Kc * Kr \qquad (1)$$

$$IW = \left[\frac{ETo * Kc * Kr * I}{Ea} + LR \right] * 4.2 \qquad (2)$$

Where:

IW = Irrigation water applied m^3 / fed / irrigation

ETc = Crop evapotranspiration, (mm/day)

ETo = Reference evapotranspiration, (mm/day)

Kc = Crop coefficient.

Kr = Reduction coefficient.

I = Irrigation intervals, day

Ea = Irrigation efficiency, 90%.

LR = Leaching requirement = 10% of the total amount water delivered to treatment.

Reference evapotranspiration (ETo) was calculated using the modified Penman-Monteith equation (Doorenbos and Kassam, 1979). Crop coefficient (Kc) was calculated according to (Hernández *et al*., 1994a and 1996) and a reduction coefficient was calculated according to the method by (Keller and Karmeli, 1975).

Parameters to measure vegetative growth were as follow:

1-Plant height (cm) was measured from the trunk to the highest point in the stem; it recorded at the end of each growth season.

2-Plant stem diameter (cm) was measured by caliper at 5 cm height above the ground.

3- Plant fresh and dry weights were determined for 10 leaves per plant at the end of each growing season.

4-Leaf area (cm^2) was estimated using five leaves selected from each plant according to the method by Radwan (1973).

2.1 **Isoenzyme analysis**:

Representative bulk sample from each treatment was selected and subjected to peroxidase analysis. This technique was used to provide a preliminary idea about treatments expected to induce mutants.

2.2 Preparation of Crude Extract:

Three grams of fig tissues were frozen in liquid nitrogen. Fig sample was grinded in mortar and added to 9 ml of 50 mM K-phosphate pH 7.0. after that it was centrifuged at 12,000 rpm for 30 min at 4°C and the supernatant passed through filter paper (Ambreen *et al*., 2000; Zia, 2002). This extraction was subjected to enzyme assay and protein estimation.

2.3 Peroxidase assay according to Kamel& Ghazy (1973):

Peroxidase activity using guaiacol was carried out in reaction mixture containing in one ml volume 8 µ moles of H_20_2, 60 µ moles guaiacol, 150 µ moles sodium acetate buffer, pH 5.6 and peroxidase concentration which gave linear response over a period of 3 min. The change in absorbance at 470 nm due to guaiacol oxidation was followed at 30 second intervals. One unit of peroxidase activity was defined as the amount of enzyme which causes an increase of one O.D. unit per min at 25 C under the assay conditions.

2.4 Electrophoretic analysis:

Native polyacrylamide gel electrophoresis (7% PAGE) was carried out according to Smith, (1969). SDS-PAGE was performed according to Laemmli, (1970) and Weber and Osborn, (1969). The proteins were stained with 0.25% coomassie brilliant blue R-250.

2.5 Peroxidase staining:

The gel is dipped in freshly prepared solution contained 266 µ moles of H_20_2, 2000 µ moles guaiacol in 100 ml of 0.05M sodium acetate buffer, pH 5.6 and the enzymatic reaction was blocked by 7 % acetic acid.

2.6 **Protein determination**:

Protein concentration was determined according to the method of Bradford (1976). Bovine serum albumin (BSA) was used as a standard.

2.7 **Gel scanning**:

Protein bands revealed on gels were scanned with Video Copy Processor P65E (Appligene). Quantitative determination of the resolved protein bands was carried out using total laboratory Software, Microsoft.

2.8 Experimental Design & data analysis:

The experiment was carried out as factorial in randomized complete block design RCBD with three replications (three plants / replicate) during the two seasons of 2011 & 2012. Data in this study were statistically analyzed using the SAS (Statistical Analysis System) version 8.1 according to Gomez and Gomez (1984). Least Significant Differences (L.S.D) at 0.05 used to compare the differences among means according to Snedecor and Cochran (1967).

3. RESULTS

3.1 **Plant height**:

From data in Table (1) it's concluded that, the cultivar Gizy had the highest significant plant height throughout both studied seasons compared with Aboudi cultivar. It also showed that, plant height of both studied cultivars reduced significantly with each reduction in water requirements. The highest significant plant height was obseved in plants irrigated with 100% of the ETc. On the other hand, the lowest significant plant height was observed in plants irrigated with 50% of the ETc. The trends of results were true in both studied seasons.

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Highlighting the effect of interaction between cultivars and irrigation regimes, the highest significant plant height observed when the cultivar Gizy irrigated with 100% from the ETc during both studied seasons. The second high significant plant height was found as a result of the interaction between Aboudi and 100% from the ETc in the first season. While, during the second season, interaction between Gizy and 75% and Aboudi irrigated with 100% recorded the second highest significant values without significant different between them. However, interactions between the two studied cultivars and 50% presented the lowest values of plant height during the two studied seasons.

Table (1): Effect of fig cultivars, irrigation treatments and it's interaction on plant height (cm) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	54.67 a	43.83 b	**49.25 a**	64.23 a	57.40 ab	**60.82 a**
75%	42.50 bc	37.50 bc	**40.00 b**	63.40 a	49.90 ab	**56.65 ab**
50%	35.23 c	36.33 bc	**35.78 b**	45.90 b	45.73 b	**45.82 b**
Mean	**44.13 a**	**39.22 b**		**57.84 a**	**51.01 a**	

3.2 Stem diameter:

Data in Table (2) showed the effect of cultivars, irrigation treatment and there interaction on fig stem diameter. Gizy cultivar had a significant bigger stem diameter compared with Aboudi cultivar in the two studied seasons.

Stem diameters reduced gradually with each reduction in the amount of irrigation water. In other words, the highest significant value of stem diameter was recorded with 100% of the ETc, followed by those with 75% of the ETc. However, the lowest value of stem diameter recorded in plants that irrigated with 50% of the ETc. No significant difference was observed between stem diameters of plants that irrigated with 75% or 50%. The demonstrated result was true during the first season.

Regarding results of second season, no significant effect was detected as a result for the irrigation regime application, but the values of the stem diameter appeared to be in similar order to those in the first season (stem diameter of plants irrigated with 100% followed by 75% and finally 50% of the ETc).

It's clear from Table (2) that the interaction between cultivars and irrigation regime affected stem diameter significantly during both studied seasons. Interaction between Gizy and 100% recorded the highest significant values of stem diameter in the studied seasons. Moreover, interaction between Aboudi and both of 75% and 50% were significantly the lowest values of stem diameter in both seasons and without significant different between them.

Table (2): Effect of fig cultivars, irrigation treatments and it's interaction on stem diameter (cm) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	1.90a	1.10bc	**1.5a**	2.17a	1.40 b	**1.78a**
75%	1.40b	1.03c	**1.22b**	1.67ab	1.27 b	**1.47a**
50%	1.23bc	1.00 c	**1.12b**	1.60ab	1.20 b	**1.40 a**
Mean	**1.51a**	**1.04b**		**1.8 a**	**1.29 b**	

3.3 Leaves fresh weight:

Leaves fresh weight affected significantly by fig cultivars (Table 3). The highest significant leave fresh weight was recorded in Gizy cultivar in both studied seasons.

Irrigation regime effected significantly in leave fresh weight. The highest leave fresh weight was detected with 100%, significantly followed by 75% and the lowest significant value was recorded in 50% of the ETc.

Table (3) also showed that the interaction between Gizy and 100% of the ETc results the highest significant leaves fresh weight during the two studied seasons. Furthermore, the second high values was detected in Aboudi irrigated with 100% of the ETc followed by interaction between Gizy and 75% without significant different between them. Same result was true in the second season but in reverse order. On the other hand, lowest significant leave fresh weight was represented in the interaction of Aboudi and 50% of the ETc in both studied seasons.

Table (3): Effect of fig cultivars, irrigation treatments and it's interaction on leave fresh weight (g) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation	First season 2011			Second season 2012		
% of ETc	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	5.63 a	3.41 b	**4.52 a**	3.34 a	2.41 ab	**2.88a**
75%	3.08 b	2.72bc	**2.90 b**	2.67 ab	2.07b	**2.37ab**
50%	2.42 bc	1.76 c	**2.09 c**	2.44 ab	1.56 b	**2.00b**
Mean	**3.71 a**	**2.63 b**		**2.82 a**	**2.01 b**	

3.4 Leaves dry weight:

Table 4 indicated that Gizy cultivar had significantly the highest leave dry weight compared with Aboudi cultivar in both studied seasons. Similar to leave fresh weight, values of leave dry weights were in a descending order with each reduction in the irrigation regime in both studied seasons. Such result appears in highest significant leave dry weight in plants irrigated with 100% followed by those irrigated with 75% and the lowest was found when irrigation with 50% of the ETc was applied.

The highest significant leave dry weight found with the interaction between Gizy irrigated with 100% of the E_{tc} during the two studied seasons. The second high value of leave dry weight was observed with Aboudi irrigated with 100% of the Etc, followed by Gizy irrigated with 75% without any significant different between them. However, in the second season interaction between Gizy irrigated with 75% of the ETc was higher than Aboudi irrigated with 100% and without significant different between them. In the contrary, the lowest significant leave dry weight was found in the interaction between the two cultivars and 50% of the ETc in both studied seasons.

Table (4): Effect of fig cultivars, irrigation treatments and it's interaction on leave dry weight (g) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation	First season 2011			Second season 2012		
% of ETc	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	1.50 a	0.90 b	**1.2 a**	0.96 a	0.53 bc	**0.75 a**
75%	0.89 b	0.73 bc	**0.81 b**	0.77 ab	0.48 bc	**0.63 ab**
50%	0.62 c	0.50 c	**0.56 c**	0.64 bc	0.37 c	**0.51 b**
Mean	**1.00 a**	**0.71 b**		**0.79 a**	**0.46 b**	

3.5 Leaves area

From Table (5) it is concluded that the cultivar Gizy gave the highest significant leaves area comparing with Aboudi cultivar in the two studied seasons. In addition, irrigation regime has a significant effect on leaves area. Irrigation with 50% of the ETc, recorded the lowest significant leaves area compared with other studied irrigation regimes (100% and 75% of the ETc) in both studied season. While, plants irrigated with 100% of the ETc recorded significantly the highest value of leaves area followed by 75% of the ETc. Such result was true in both studied seasons.

Table (5) also indicated that irrigation treatment of 100% of the ETc was significantly highest in leaves area followed by Aboudi irrigated with 100% of the ETc, in both studied seasons. While the lowest significant leave area was recorded in Aboudi irrigated with 50% of the ETc, followed by Gizy irrigated with 50% of the ETc, without any

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significant different between them during the two studied seasons. It was also noted that, no significant different were found with both interactions between Aboudi and 100% and interaction between Gizy and 75% or Aboudi irrigated with 75% of the ETc in the two studied seasons.

Table (5): Effect of fig cultivars, irrigation treatments and it's interaction on leaves area (cm) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation	First season 2011			Second season 2012		
% of ETc	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	130.66 a	74.66 b	**102.66 a**	131.46 a	75.46 b	**103.46a**
75%	73.42 bc	71.76 bc	**72.59 b**	74.22 b	72.85 b	**73.54 b**
50%	60.09 cd	46.46 d	**53.27c**	61.52 bc	47.26c	**54.39 c**
Mean	**88.06 a**	**64.29 b**		**89.07 a**	**65.19 b**	

3.6 Leaves water content

Result in Table (6) show that Gizy had the highest significant water content in leaves compared with the Aboudi cultivar. The highest significant leave water content was detected in plants that irrigated with 100% of the ETc followed by those irrigated with 75%. However, the lowest significant value was observed in plants irrigated with 50%. Moreover, during the first season, no significant different was found in leave water content in plants irrigated with 75% and those irrigated with 50% of the ETc during the first season. While, a significant different was found between all studied irrigation regime during second season.

Interaction between Gizy and 100% ranked the first with the highest significant leave water content during both studied seasons. Second significant leave water content was recorded in Aboudi interacted with 100% followed by interaction between Gizy and 75% of the ETc, without significant different between them. Furthermore, the lowest significant leave water content was found with Aboudi irrigated with 50% during both studied seasons.

Table (6): Effect of fig cultivars, irrigation treatments and it's interaction on leave water content of two fig cultivars during the 2011 and 2012 seasons.

Irrigation	First season 2011			Second season 2012		
% of ETc	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	4.13 a	2.50 b	**3.32 a**	2.38 a	1.88 ab	**2.13 a**
75%	2.19 b	1.99 bc	**2.09 b**	1.90 ab	1.58 ab	**1.74 a**
50%	1.80 bc	1.26 c	**1.53 b**	1.79 ab	1.20 b	**1.50 b**
Mean	**2.71 a**	**1.92 b**		**2.02 a**	**1.55 a**	

3.7 Leaf free amino acid content

Table (7) show that the response of cultivars to leaf free amino acid contents had a trend contrary to the vegetative growth trend. The highest significant free amino acid in leaves was recorded with Aboudi cultivar during the two studied seasons.

Hence, the highest significant free amino acid in leaves was detected in plants that irrigated with 50% of the ETc, followed by those irrigated with 75% and finally plants that irrigated with 100% of the ETc. No significant different between free amino acid in leaves of plants irrigated with 50% or 75% of the ETc. The same trend was found in the second season.

The highest significant free amino acid was observed when Aboudi cultivar interacted with 50% in both studied seasons. Second highest free amino acid was recorded in Gizy interacted with 50% of the ETc. Lowest significant free amino acid was detected in interaction of Gizy and 100% of the ETc. The same trend was true for both studied seasons.

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Table (7): Effect of fig cultivars, irrigation treatments and it's interaction on leaves free amino acid of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	64.37 c	71.59 bc	**67.98 b**	65.37 c	71.89 bc	**68.63 b**
75%	75.12 bc	77.52 ab	**76.32 a**	75.63bc	78.01 ab	**76.82 a**
50%	75.45 b	86.71 a	**81.08 a**	75.75bc	87.72 a	**81.74 a**
Mean	**71.65 b**	**78.61 a**		**72.25 b**	**79.21 a**	

3.8 Leaf proline content

Levels of proline content in leaves affected significantly by cultivars and irrigation regimes as well as the interaction between them (Table 8). The highest significant proline was found in leaves of Aboudi cultivar throughout the two studied seasons. However the irrigation regime 50% of the ETc gave, significantly, the highest content of proline in leaf. Second highest significant proline content was detected in plants irrigated with 75% of the ETc. Moreover, lowest significant leaf proline content was observed in plants that irrigated with 100% of the ETc. It's notable from data in Table (8) that, no significant different was detected between proline content of plants irrigated with 75% or 100% of the ETc. The mentioned trend of results was confirmed for the two studied seasons.

Interaction between Aboudi and 50% of the ETc was significantly the highest in leaf proline content. Moreover, no significant different was observed within other studied interactions during both studied seasons.

Table (8): Effect of fig cultivars, irrigation treatments and it's interaction on leaf proline content of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	0.46 b	0.42 b	**0.44 b**	0.41 b	0.39 b	**0.40 b**
75%	0.44 b	0.56 b	**0.50 b**	0.44 b	0.56 b	**0.50 b**
50%	0.41 b	0.86 a	**0.64 a**	0.46 b	0.86 a	**0.66 a**
Mean	**0.43 b**	**0.62 a**		**0.44 b**	**0.60 a**	

3.9 Protein content

Cultivar Aboudi was significantly the lowest in protein content, while Gizy was significantly the highest (Table 8). The same result was found during the second season.

A significant increment was recorded with every decrement in the irrigation regime from 100% to 75% and then 50% of the ETc. In another words, the highest significant protein content was recorded with the irrigation regime 50% followed by 75% of the ETc. However, the lowest significant proteins activity was observed in 100% water regime.

Regarding the interaction between fig cultivars and irrigation regimes, the highest significant interaction was detected in plants of Gizy irrigated with 50% in both studied seasons. Moreover, interaction between Aboudi and 100% recorded the lowest significant protein content during both studied seasons.

Table (9): Effect of fig cultivars, irrigation treatments and it's interaction on protein content (mg/ml) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	0.173b	0.225b	**0.199B**	0.915b	0.345b	**0.63B**
75%	0.378a	0.252b	**0.315B**	1.001b	0.445b	**0.723B**
50%	0.633a	0.183b	**0.408A**	2.85a	0.236b	**1.54A**
Mean	**0.395A**	**0.22B**		**1.589A**	**0.342B**	

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3.10 Peroxidase activity

It was noted from data in Table (10) that, the peroxidase activity was significantly the highest in plants of Gizy compared with Aboudi during the two studied seasons.

It also indicated that, tested irrigation regimes significantly affected peroxidase activity during both studied seasons. The highest significant peroxidase activity was observed in fig plants irrigated with 75% of the ETc followed by those irrigated with 100%. The lowest significant peroxidase activity was recorded in plants irrigated with 50% of the ETc.

Interaction between fig cultivars and different tested irrigation regimes significantly affected peroxidase activity. The highest significant peroxidase activity was detected when plants of Gizy irrigated with 75% of the ETc. The same results were confirmed in the second seasons.

Table (10): Effect of fig cultivars, irrigation treatments and it's interaction on Peroxidase activity (units/ml) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	3.03a	2.84b	**2.935B**	14.59a	2.68d	**8.635A**
75%	3.98a	3.91a	**3.945A**	8.09b	4.49c	**6.29B**
50%	2.85b	1.62c	**2.235B**	1.46e	0.54f	**1.00C**
Mean	**3.28A**	**2.79B**		**8.05**	**2.57**	

3.11 Specific activity of peroxidase

Table (11) shows that cultivar Gizy was significantly the highest in specific activity of peroxidase compared with the cultivar Aboudi during both studied seasons.

Moreover, the irrigation regime 100% of the ETc. reflected the highest significant specific activity of peroxidase followed by 75% without significant different between them. The lowest significant specific activity of peroxidase was found in plants irrigated with 50% of the ETc. The same trend of results found during the second season.

The same table also shows that the highest values of specific activity of peroxidase were observed when plants of Gizy irrigated with 100% of the ETc, followed by plants of the same cultivar irrigated with 75% of the ETc.

Table (11): Effect of fig cultivars, irrigation treatments and it's interaction on specific activity (units/mg) of two fig cultivars during the 2011 and 2012 seasons.

Irrigation % of ETc	First season 2011			Second season 2012		
	Gizy	Aboudi	Mean	Gizy	Aboudi	Mean
100%	17.51a	3.96c	**10.73A**	15.9a	2.5c	**9.20A**
75%	10.52b	10.02b	**10.27A**	8.08b	6.75b	**7.42A**
50%	4.5c	2.74c	**3.62B**	1.209d	2.52c	**1.86B**
Mean	**10.84A**	**5.57B**		**8.40A**	**3.92B**	

1st season

a- Peroxidase activity

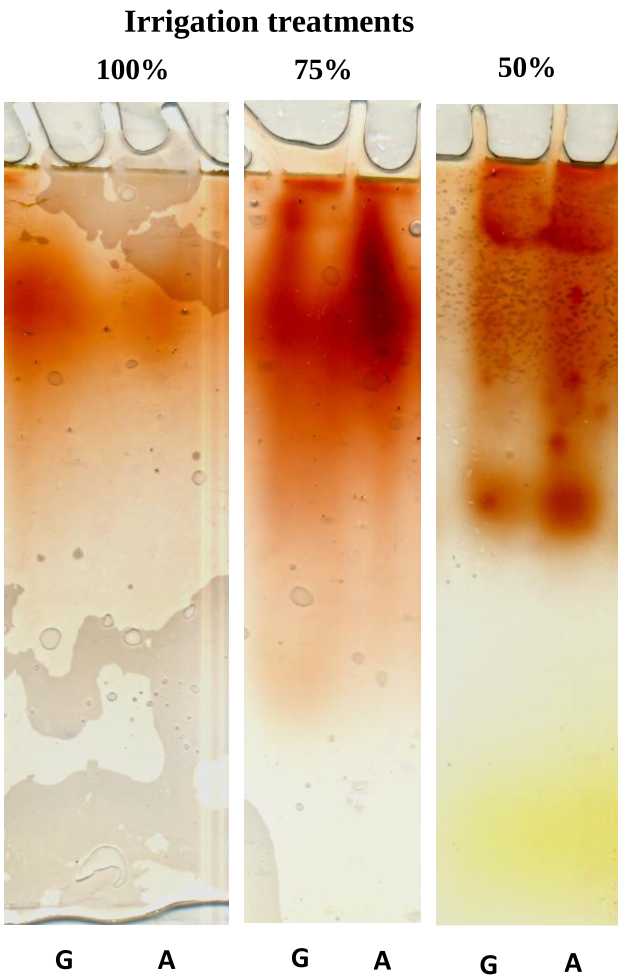

Fig. (1): Isoenzyme pattern on 7% native polyacrylamide gel: (1) Gizy cultivar (G) and Aboudi cultivar (A) by 100% ETc. (2) Gizy cultivar (G) and Aboudi cultivar (A) by 75% ETc. (3) Gizy cultivar (G) and Aboudi cultivar (A) by 50% ETc during 2011.

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2nd season

a- Peroxidase activity

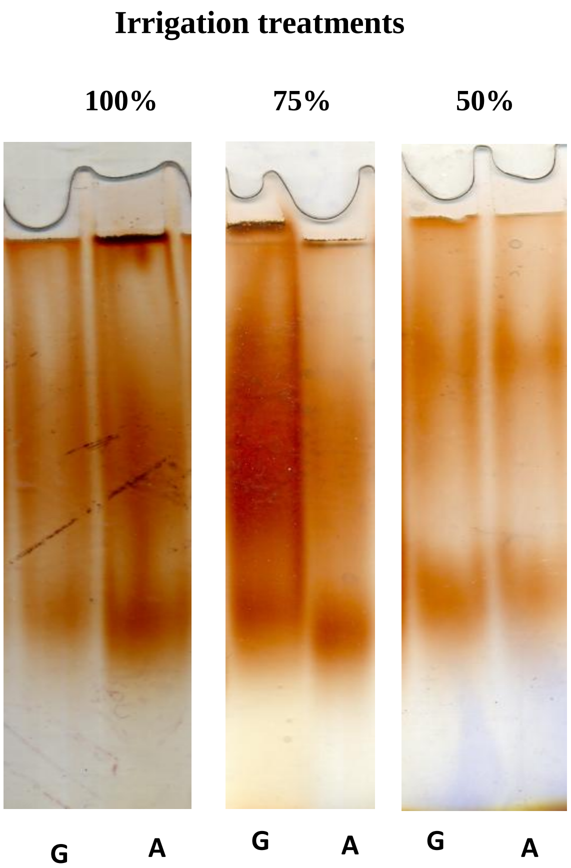

Fig. (3): Isoenzyme pattern on 7% native polyacrylamide gel: (1) Gizy cultivar (G) and Aboudi cultivar (A) by 100% ETc. (2) Gizy cultivar (G) and Aboudi cultivar (A) by 75% ETc. (3) Gizy cultivar (G) and Aboudi cultivar (A) by 50% ETc during 2012.

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4. DISCUSSION:

In Egypt, there are numerous local Fig cultivars with a variety of sizes, shapes, ripening times, skin and pulp colors and taste. Morphological characterization and the protection of this genetic diversity for future generations are very important. Concerning the reduction and scarcity of fresh water, one of the suggested strategies for a sustainable increase in Fig production is screening existed cultivars for drought tolerance. Such strategy will help in breeding programs, as well as increasing the cultivated area of the chosen tolerant cultivar.

In this study, vegetative growth characteristics, proline and protein contents and Peroxidase activity for two local Fig cultivars were identified under two irrigation regimes compared with total needed water requirement.

From the illustrated results, adverse effect of drought stress on vegetative growth of both studied cultivars is well documented. Growth reduction by water deficit stress is caused by changes in several physiological and morphological processes such as reduced stem elongation, stem diameter, leaves area and leaves fresh weight of the plants under water deficit stress (Tables 1, 2, 3, 5 and 6). The mentioned reduction in vegetative growth characteristics was in accompanied by an increase of free amino acid and proline contents (Tables 7 and 8). The same results were found by Rostami and Raheini (2013). They explain the reduction in fig tree vegetative growth to the reduction in relative water content and leaf water content.

The reduction in plant height (Table 1) could be attributed to decline in cell enlargement and massive leaf abscission in plant under water stress (Manivannan *et al.*, 2007).

Regards leaf area, all reviews reported that the leaf area expansion depends on leaf turgor, temperature, and assimilating supply for growth. Drought-induced reduction in leaf area is ascribed to suppression of leaf expansion through reduction in photosynthesis (Rucker *et al.*, 1995). Reduced leaf area and defoliation represent an adaptation strategy by diminish water loss and increasing water deficit tolerance (Halim, 1989).

Moreover, stem and leaf growth may be inhibited at low water potential. This suggests that the growth inhibition may be metabolically regulated possibly serving an adaptive role by restricting the development of transpiring area under water stress condition (Sharp, 1996).

Trunk diameter also reflects the effect of water stress. Reduced water availability causes shrinking of xylem vessels and reduced radial growth of trunk (Rostami and Raheini, 2013).

Drought resistant species might be expected to be adapted to large losses of water without loss of turgor, and the leaf cells would be small and thick walled causing low fresh weight/dry weight ratios (Liu and Stutzel, 2002).

Water stress significantly reduced leaves water content of the fully expanded leaves (Table 6). Available high leaves water content under water stress usually has been considered as a good indicator of drought tolerance (Shaw *et al.*, 2002). The results showed significant reduction in leaves water content of both studied fig cultivars under drought stress, which was in accordance to Karimi *et al.* (2012) and Gholami *et al.* (2012). Maintaining leaves water content has been reported to play an important role in stress tolerance of Fig (Karimi, *et al.*, 2012).

In addition, Thakur (2004) reported that, under drought stress conditions, cultivars with lesser decline in leaves water content were capable of retaining higher internal water status, which enable the plant to maintain hydration of protoplasm for longer duration

Concerning proline content, it was notable that water stress increased proline accumulation in the leaves of Aboudi cultivar. Karimi *et al.* (2012) reported a marked increase in proline content in a drought tolerant fig cultivar under water stress. Water stress induces proline accumulation in many plant species by increasing its biosynthesis and/or inactivation of its degradation (Hare *et al*., 1999). Proline as an osmoregulator, or as an osmo-protector may help plant tolerate water stress (Ozden *et al*., 2009). Turkan *et al*. (2005) and Verslues *et al*. (2006) showed that proline acts as a cell membrane stabilizer and may protect cells against oxidative stress during dehydration.

5. CONCLUSION

The purpose of the current investigation was to select the tolerant fig cultivar from the two studied cultivars. Result of vegetative growth confirmed that, among the two tested cultivars, Gizy cultivar was the highest in all measured vegetative growth parameter. As well as, leaves water content, protein content, peroxidase activity and specific activity

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of peroxidase. On the other hand, parameters that confirmed the sensitivity such like leaf free amino acid and prolin content in leaf recorded the highest values in the cultivar Aboudi. Finally, it's concluded that, the cultivar Gizy is tolerant to drought stress comparing to the cultivar Aboudi.

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