Plant Archives Vol. 18 No. 2, 2018 pp. 2605-2608 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

TOLERANCE SUSCEPTIBILITY OF *VIGNA SINENSIS* PLANT TO ABSCISIC ACID STRESS

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Abstract

A field experiment was conducted in the Botanical garden of the Department of Biology, College of Education for Pure Science (Ibn Al-Haitham), University of Baghdad to study the effect of foliar application at different concentrations (15 ppm, 10 ppm) in addition to control treated of abscisic acid in some of the vegetative characteristics of *Vigna sinesis* plant. The resulted showed the affected of leaf area and total content of chlorophyll and proline at the concentration of 15 ppm, while at the time of harvest, the concentration of 10 ppm was the highest resulted in the leaf area character, leaf area index and leaf area proportion.

Key words: Stress, Abscisic acid, *Vigna sinesis*

Introduction

Vigna sinesis plant is one of the oldest crops that man has cultivated and used as a source of food, and is currently cultivated on a large ranged in the whole world. The mature seed and green pods is used in human food and it has high nutritional quality (Ali *et al.*, 1990). This plant belongs to Fabaceae family and characterized by its ability to fix the nitrogen in the soil by the bacterial nodes, and the family that its fruits are in the form of pods and contain seeds and are among the most important of the flowering dicotyledon families (Author, 1988). The seeds of *Vigna sinesis* contain the high percentage of protein and a high percentage of thiamine and also contain a proportion of amino acids ranging from 0.35-0.90% in most varieties, as well as containing vitamin B, C (Tlass, 2008).

Plants are exposed to different types of stress that may occur because of environmental factors such as heat, salinity and high soil content of carbonate minerals, which may be chemically with the presence of substances such as abscisic acid (Arora *et al.*, 2002). Abscisic acid (ABA) is one of the inhibited hormones to many vital events and most studies indicate that the ABA builds in the chloroplast of the mesophyll and the high pH helps to accumulate. Abscisic acid is available in the phloem of the plant and moves to the top of the plant and to the roots. The ABA has many physiological effects including inhibitory growth, buds and seed latency, and stomata movement where it is act to close the stomata plant when it is exposure to various stresses and separation of leaves and works to accelerate the aging of plant parts as well as effect on synthesis of protein in the plant (Yassin, 2001).

The exposure of the plant to the stress of the ABA increases the plant content of the proline which has the role in the production of energy inside the plant cell (Shahat, 2002). The proline also increases the resistance of the plant to the wilting and aging (Chinnusamy *et al.*, 2005). The proline is located in various plant parts but it moves from the leaves to the growth apex when the plant is exposed to stress (Mattioli *et al.*, 2008). Proline has an active role in controlling the biological processes within the plant, controlling the production of active oxygen inside the plant cell as well as affecting the specific enzymes of the photosynthesis process (Szabados and Savours, 2010).

Materials and Methods

The experimental field was conducted in the Botanical garden of the department of Biology, College of Education for Pure Science (Ibn Al-Haitham), University of Baghdad. The soil was initialized for cultivation and settlement of tillage, the seeds of the *Vigna sinesis* local species were planted in the form of gore on 15/3/2016 in

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accordance with Randomized complete Block Design (R.C.B.D) (Sahuki and Wahib, 1990), with three replicates per treated in addition to the treatment of control.

The abscisic acid was prepared by doing the original solution (Stock) and was attended by the used concentrations in the experiment 10 ppm and 15 ppm. The plant sprayed (at the age of 4-6 leaves) in the early morning by using a handy sprinkler with a little addition of liquid cleaner until full wet (Brayan, 1999).

The following measurements were taken:

1. Leaf area (cm^2) three replicates per treated: The leaf area is calculated in the disc method (Abu-El. Zahab *et al.,* 1979) by the following equation:

$$Leaf\ area = \frac{Dry\ height\ of\ leave}{Dry\ height\ of\ dics} \times dics\ area$$

2.Leaf area index (cm^2): According to the leaf area index and three replicates per treated according to the following equation:

$$Leaf\ area\ propotion = \frac{Leaf\ area\ of\ plant}{The\ area\ occupied\ by\ the\ plant}$$

(Khawaja, 1995)

3. Leaf area proportion ($cm^2.gm^{-1}$): The percentage of leaf area at three replicates per treated is calculated according to the following equation:

$$Leaf\ area\ propotion = \frac{Leaf\ area\ of\ plant}{Dry\ weight\ of\ plant}$$

(Kardiner *et al.,* 1990)

4. Chlorophyll concentration A, B and total ($mg.gm^{-1}$): The concentration of chlorophyll a, B and total were estimated at three replicates per treated (Lichtanthaler, 1987; Mac-Kinney, 1941). The photosynthesis pigments were estimated by using the following equations:

Chlorophyll a ($mg.gm^{-1}$)

$$= 1.25\times(D663)-2.79\times(D645)\times W\times^{V} 1000$$

Chlorophyll b ($mg.gm^{-1}$)

$$= 1.25\times(D663)-2.79\times(D645)\times W\times^{V} 1000$$

Chlorophyll total ($mg.gm^{-1}$)

$$= 20.2\times(D645)+8.02\times(D663)\times W\times^{V} 1000$$

Whereas:

D= Optical density

D663= Optical density to the wave length 663 nm

D645= Optical density to the wave length 645 nm

V= Total volume of extracted (50 ml)

W= Weight of foliar tissue (1 gm)

5. Proline content in the leaves ($mg.gm^{-1}$ tissue fresh weight): The proline was estimated in the leaves at three replicates per treated (Bates *et al.*, 1973) and the following equation was adopted:

Proline ($mg.gm^{-1}$ tissue fresh weight) =

$$\frac{Reading\times 20}{Plant\ sample\ weight\ EgmF} \times 1.47$$

6. The data were statistically analysed by LSD at the level of probability of 0.05 (SAS, 2012).

Results and Discussion

Table 1 results show a significant effect at 15 ppm concentration in the leaf area, leaf area index and leaf area proportion where rates of increase 1.38%, 1.38% and 0.47%, respectively, compared with the control treatment. Abscisic acid has increased vegetative growth in the first phase after spraying where photosynthesis is stimulated and thus increasing the amount of material produced and thereby increasing the characteristics of leaf area, leaf area index and leaf area proportion because the effect of abscisic acid is weak in the early stages of spraying but after 3-4 weeks the effect of abscisic acid is clear where it worked on the closure of the stomata and effects on the synthesis of protein in the plant whereby the effect of stress begins to manifest (Yassin, 2001).

Table 1: Tolerance susceptibility of *Vigna sinesis* to stress of abscisic acid in the characteristics of leaf area (cm^2), leaf area index (cm^3) and leaf area proportion ($cm^2.gm^{-1}$).

Concentration	Leaf area (cm^2)	Leaf area index (cm^3)	Leaf area proportion ($cm^2.gm^{-1}$)
0	43.02	4.30	12.45
10 ppm	89.59	8.96	16.39
15 ppm	102.68	10.27	18.38
LSD (0.05)	26.82	2.68	7.17

While table 2 showed a significant increase in total chlorophyll in the concentration of 15 ppm, with a slight increase of 0.58%, due to the increase in the concentrations high for abscisic acid leads to increasing the content of the leaves of chlorophyll (Iqbal *et al.,* 2010). The growth rate of the leaf increases and the leaf area increases as it is clear in table 1 and thus increase the

number of chloroplast and increase the total amount of chlorophyll and increase the amount of material generated from the photosynthesis process (Al-Saadi, 2017).

Table 2: Tolerance susceptibility of *Vigna sinesis* to stress of abscisic acid in the characteristics of chlorophyll a, chlorophyll b and total chlorophyll (mg.gm^{-1} tissue).

Concentrations	chlorophyll a	chlorophyll b	Total
0	0.74	0.33	1.22
10 ppm	0.94	0.41	1.55
15 ppm	0.89	0.49	1.58
LSD (0.05)	N.S.	N.S.	0.34

While the results of proline acid content showed a clear increase at 15 ppm concentration, where the increase was 3.00% compared with the treatment of control. The abscisic acid of the hormone inhibitory of some vital events whereas the proline in the cell that has the role in the production of energy inside the plant cell as well as increases plant resistance to the wilting and aging (Shahat, 2000; Chinnusamy *et al*., 2005). The presence of abscisic acid helps to increase cellular oxidation in the plant and thus increase the active oxygen elements of ROS, and because the presence of the proline absorbs free radicals and preserves the plant cell (Zhang *et al*., 2001).

The results of a table (4) showed a significant decrease in the characteristics of leaf area, leaf area index and leaf area proportion at harvest and the concentration of 15 ppm where the ratio was 0.37%, 0.37% and 0.35% respectively. Abscisic acid has an effect on the plant, especially the leaf and its area, and also has a negative and inhibitory effect of the vegetative parts through its effect on the growth and elongation of plant cells (Chave *et al*., 2009). It also affects the chloroplast and thus fixed CO_2 and causes clear plant wilt and the lack of necessary nutrient accumulation, which affects leaf area, leaf area index and leaf area proportion (Lioa *et al*., 2008).

Table 3: Tolerance susceptibility of *Vigna sinesis* to stress of abscisic acid in the characteristics of proline (mg. gm^{-1} tissue fresh weight).

Concentration	Content of proline acid mg.gm^{-1} tissue fresh weight)
0	5.92
10 ppm	7.89
15 ppm	8.92
LSD (0.05)	0.11

Table 4: Tolerance susceptibility of *Vigna sinesis* to stress of abscisic acid in the characteristics of leaf area (cm^2), leaf area index (cm^3) and leaf area proportion (cm^2. gm^{-1}) at harvest.

Concentration	Leaf area (cm^2)	Leaf area index (cm^3)	Leaf area proportion (cm^2. gm^{-1})
0	16.83	1.68	14.34
10 ppm	16.21	1.62	14.36
15 ppm	10.78	1.07	9.31
LSD (0.05)	4.63	0.46	2.38

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