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Effect of electric and heat shock on morphological characteristics for two varieties of wheat

Mohammed M. Hawash*, Laith M.J. Al-Shamma
Department of Biology, Collage of Science, University of Baghdad, Baghdad, Iraq

Abstract

Wheat (*Triticum aestivum* L.) is one of the Poaceae family (Gramineae). Is momentous for human nutrition, and the stresses can affect strongly on the phenotype characteristics of the plant. The aim of this study was to determine how electric shock on germinated grain (for 2.5, 5, and 7.5 mins.) and heat shock at (35 ^{o}C, 40 ^{o}C and 45 ^{o}C) applied after phase out the radical length of 2-5 mm, from the grain of two wheat Varieties: "Baghdad 1" and "Babylon 113". The electric shock for 2.5 mins., lead to delay of flowering, from day to 50 % flowering was 93 day, as well as, gave lowest value of plant height 64.5cm and lowest spike length was 10.7 cm. While The highest flag leaf area was obtained by electric shock for 5 mins. was 56.6 cm^2 compared to control treatment which was 28.9 cm^2. The effects of heat shock at 45 ^{o}C, gave maximum plant heights was 78.3 cm and highest spike length was 15.3 cm. In response to electric and heat stress in both varieties, clear differences were observed. Baghdad 1 variety gave the minimum days from sowing date to 50% flowering was 84.85 day and maximum plant height rate 73 cm, while highest rate of flag leaf area 48.1 cm^2 and highest spike length was 13.8 cm, by Babylon 113 variety. There is significant interaction between varieties and treatments, Babylon 113 for Es 5 minutes, gave highest value of flag leaf area was 65.8 cm^2, and highest spike length 16.7 cm,. Whereas Babylon 113 for Es 2.5 minutes, gave maximum days to 50% flowering which was 93 day, lowest value of plant height 60.5 cm, and lowest spike length 10 cm.

Keywords: electric shock, heat shock, morphological traits, wheat (*Triticum aestivum* L.)

تأثير الصعق الكهربائي والحراري على الصفات المظهرية لصنفين من الحنطة

محمد مخلف هواش*، ليث محمد جواد الشماع
قسم علوم الحياة ، كلية العلوم ، جامعة بغداد ، بغداد ، العراق

الخلاصة:

حنطة الخبز (*Triticum aestivum* L.) من العائلة العشبية (النجيلية). بالغ الأهمية لتغذية الإنسان، والإجهاد يمكن أن يؤثر وبقوة على الصفات المظهرية للنبات. هدف الدراسة تحديد تأثير الصعق الكهربائي على الحبوب النامية بفترات (2.5و 5 و7.5 دقيقة) والصعق الحراري في (35 م^{o} و 40 م^{o} و45 م^{o}) طبقت بعد مرحلة ظهور الجذير بطول 2−5 ملم. لصنفين من الحنطة هما "بغداد 1 "و" بابل 113 ".أظهرت النتائج الصدمة الكهربائية ل2.5 دقيقةِ. أدت الى التأخير في التزهير 50 % تزهير بلغ 93 يوم بالإضافة الى أقل إرتفاع نبات 64.5 سم وأقل طول سنبلة بلغ 10.7 سم. بينما مساحة ورقة العلم الأعلى حصل عليها بالصدمة الكهربائية 5 دقائق. بلغت 56.6 سم^2 مقارنة بمعاملة السيطرة التي كانت 28.9 سم^2 . في حين تأثير الصعق الحراري عند 45 م^{o} ، أعطى أعلى أرتفاع نباتِ بلغ 78.3 سم وأعلى طولَ سنبلة بلغ 15.3 سم. الأستجابة للصعق الكهربائي و الحرارة لكلا الصنفان، الإختلافات لوحظت. أعطى صنف بغداد 1 أقل

*Email: moh717993@gmail.com

أيام من تأريخِ البذر إلى 50 % تزهير بلغت 84.85 يوم وأقصى أرتفاع نبات 73 سم، بينما أعلى مساحة ورقة علم 48.1 سم^2 و أعلى طول سنبلة كان 13.8 سم، للصنف بابل 113. وجد هناك تداخل معنوي بين الاصناف والمعاملات، الصنف بابل 113 والصعق الكهربائي لمدة 5 دقائق، أعطى أعلى مساحة ورقة علم بلغت 65.8 سم^2، و أعلى طول سنبلة 16.7 سم،. بينما الصنف بابل 113 والصعق الكهربائي لمدة 2.5 دقيقة، أعطى أقصى أيام إلى 50 % تزهير الذي كان 93 يوم وأقل إرتفاع نبات 60.5 سم، وأقل طول سنبلة 10 سم.

Introduction

Wheat (*Triticum aestivum* L.) is one of the poaceae family (gramineae). Is the most widely grown cereal crop in the world and one of the central pillars of global food security. About 651 million tons of wheat was produced on 217 million hectares in 2010 with productivity level of 3 t/ha^{-1} [1,2]. Bread wheat was one of the first domesticated crops and, for 8,000 years.

The use of electrical energy to influence the response of biological systems was first attempted, according to [3], in 1746 by Dr. Maimbray of Edinburgh. He electrified two myrtle plants for the entire month of October and observed, that they put forth small branches a few inches in lengtli and even began to blossom. Several myrtle plants close by but not electrified showed none of these responses. Since Dr. Maimbray, many investigators have studied the use of electrical energy to influence plant growth [4]. At present, the adoption of mutations in the breeding programs can be either through the evaluation and propagation mutation and launched a variety, or by use in the cross for the production of hybrids or isolationist generations of new genetic variability invested electric energy to create variations and genetic in the plant to consider that an electric current higher difference between voltage low current experienced by plants as a result of higher difference between voltage low in seeds or seedling from 6-26 mv, and high voltage and current used in the process of shock [5].

Almost all stages of plant life are affected by heat stress. The developmental stage at which the plant is exposed to the stress may determine the severity of possible damages experienced by the crop. During heat stress modifications in different plant processes takes place in such a way to minimize the effect and develop tolerance to sustain stressful environment. Expression of heat shock proteins (HSPs) is known to be an important adaptive strategy. Their expression varies in different species as well as in different cultivars of same species [6].

The ability of a crop plant to withstand high temperatures depends on the thermal adaptation of particular species, the duration of the exposure to high temperature and the stage of growth [7]. Therefore, every plant species appears to have a definite temperature requirement for germination, vegetative growth and flowering. However, plant species that possess the characteristics of withstanding abnormally high temperatures without being severely damaged are classified as heat resistant. In general, the two main mechanisms responsible for heat resistance in plants are avoidance and tolerance, which have been recognized by [8] for many years. Avoidance can be defined as the mechanisms, which prevent the cytoplasm from being subjected to damage by high temperatures and maintaining plants active above injury level, while, tolerance is defined as the ability of the crop to live, survive and maintain all metabolic functions when the plant tissues are actually at the high temperature [9,10]. This study have been done to illustrate the effect of electric, heat shock on some Morphological traits studies, and to assess sensitivity of wheat electric, heat shock and which could be used in wheat breeding programs.

Materials and Methods

A field experiment was grain soaked then planted in the field conducted during winter 2014- 2015 in A-Khalidiya nearly 80 km west of Baghdad. Randomized complete block design (RCBD) was used with factorial experiment with three replicates for each treatment. The area of experimental unit was (1.5m X 1m) with six lines. The space between lines was 0.15 m , to achieve planting densities (105 plants/m^2). Grains sowing was at 14 December. The fertilizers used were urea (46% N) at 120 kg ha^{-1} and triple super phosphate (46% P2O5) at 60 kg ha^{-1}. All phosphorus fertilizer was applied at planting during grain bed preparation, while urea was divided into two equal amounts. The first amount was added during the land preparation prior to planting, the second amount was added before flowering initiation [12]. All weeds were hand weeded during the course of study. The other required culture practices for growing wheat were followed as recommended.

Grains of both cultivar, Baghdad 1and Babylon 113 were used as the experimental material. Grains were obtained from the Wheat National Development Program were registered and depended by national committee for registration and dependace of categories / Ministry of Agriculture and from researchers production of agricultural researches center / Ministry of Sciences and Technology.

Electric shock treatment

The grain was calculated from each varieties and germinated inside cheese cloth even phase out the radical length of 2-5 mm, then seedling soaked then in aqueous solution (1% sodium chloride) for three hours , [11,13] so that the salt enters the plant tissue to facilitate the delivery of electrical current into the cells.Then transferred to a plastic vessel in which the same solution and connected by two electric poles AC 220 volt power source where it was put inside the seedling aluminum perforated paper with the weight of iron to make them dipped in the solution.

Electric current to open the period 2.5,5 and 7.5 minutes on the different samples were treated seedlings as compared to the other the same way except electric shock. After completing the process of shock transferred the seedling vessel in running water for three hours to expel the salt does not affect them so that in the percentage of emergence.

Heat shock treatment

Germinated grain were put on a filter paper wet basins plastic at a temperature of 25 ° C and relative humidity of 60%. Seedling with two days age were offered to heat 35°C,40°C and 45° C for one hour and then the seedling were transferred to the cold shock condition (7°C) for three hours [15-17].

Agronomic traits:

Days to 50% flowering

The calculated number of days from sowing date to 50% flowering**.**

Flag leaf area (cm^2)

Flag leaf area of 10 random plants leaves from each treatment was measured by the following equation [18].

Leaf area (cm2) = Leaf length (cm) × leaf width (cm) × 0.95).

Plant height (cm)

Plant height of 10 random plants from each treatment was measured from soil surface to the tip of main stem spike excluding awns [19].

Spike length (cm)

It is length of the part from spike base to the end of spike excluding awns.

Statistical analysis

The data were analyzed by analysis of variance for all studied characters. The means were compared with Least Significant Differences (LSD) at a level 5 %.

Results and Discussion:

Days to 50% flowering:

Table 1- Effect of electric shock and heat shock on days to 50% flowering of two wheat varieties

T / V	ES2.5 mins.	ES5 mins.	ES7.5 mins.	HS35 ^oC	HS40 ^oC	HS45 ^oC	Cont.	Mean
Baghdad1	89	82	82	89	85	82	85	84.85
Babylon 113	93	90	85	89	89	85	82	87.57
Mean	91	86	83.5	89	87	83.5	83.5	
L.S.D (5%)		L.S.D(V)=1.032		L.S.D(T)=1.931		L.S.D(V*T)=2.731		

Significant differences were observed between treatments for days to 50% flowering Table-1. Minimum days to 50% flowering were noted for Es 7.5, Hs 45 ^oC and control was 83.5 days, compared to Es 2.5, that gave maximum days was 93. Variation in this trait may be due to the phytohormone levels of indole acetic acid (IAA) at blooming was significantly higher with electric, heat shock. The different varieties including the impact of treatment with shocks can be explained to a group of genes and action responsible for this trait early in the crop [13]. Therefore, early developed seedling would be flowering earlier than other treatments,

And showed significant differences between varieties in response to different treatments, Baghdad 1 variety gave the minimum days from sowing date to 50% flowering was 84.85 days followed by Babylon 113 variety were 87.57 days. The reason for this variation might be due to the genetic variation between varieties leading to variation in the vegetative traits , The difference between cultivars, in response to shocks can be explained to a group of genes and action responsible for early flowering in the crop. These results were agreed [17].

As showed the significant interaction between varieties and treatments, interaction between (Baghdad 1 X Es 5 minutes),(Baghdad 1 X Es 7.5 minutes), (Baghdad 1 X Hs 45 ^{o}C) and (Babylon 113 X control) gave the minimum days to 50% flowering which were 82 day. While the interaction between (Babylon 113 X Es 2.5 minutes) gave maximum days to 50% flowering which was 93 days.

Flag leaf area:

Table 2- Effect of electric shock and heat shock on flag leaf area (cm^2) of two wheat varieties.

T / V	ES2.5 mins.	ES5 mins.	ES7.5 mins.	HS35 ^{o}C	HS40 ^{o}C	HS45 ^{o}C	Cont.	Mean
Baghdad1	43.3	47.4	46.1	35.3	59.2	45.8	21.2	42.6
Babylon 113	56.2	65.8	38.1	55.4	46.3	38.6	36.7	48.1
Mean	49.7	56.6	42.1	45.3	52.7	42.2	28.9	45.3
L.S.D (5%)	L.S.D (V)= 0.285			L.S.D (T)= 0.533		L.S.D (V*T)= 0.753		

Plant leaf area is an important determinant of light interception and consequently of transpiration, photosynthesis leading to plant productivity. Table-2 showed that flag leaf area was affected significantly by different treatments, The highest flag leaf area was obtained at (Electric shock for 5 minutes) was 56.6 cm^2, while control treatment gave lowest flag leaf area was 28.9 cm^2. Intercepted by plant, and thus crop productivity, by promoting leaf expansion and stimulative influence on cell and cell division [20]. The former results agree whith Jasim's opinion [21] through electric current effect on vegetative growing of flowers (Ranunculus) that leads to treat electric strick to increase leaf area.

Data in the same table showed, that there were significant differences between varieties in flag leaf area Babylon 113 variety showed the highest rate of flag leaf area 48.1 cm^2 . While the rate in Baghdad 1 variety was the lowest 42.6 cm^2, The reason for this variation might be due to that genotypes differ in most vegetative traits [22].

Results presented showed that there were a significant interaction between varieties and treatments, (Babylon 113 X Es 5 minutes) gave highest value of flag leaf area was 65.8 cm^2, while the interaction between (Baghdad 1 X Hs 35 ^{o}C) revealed the lowest value of flag leaf area 35.3 cm^2.

Plant height (cm):

Table 3- Effect of electric shock and heat shock plant height (cm) of two wheat varieties.

T / V	ES2.5 mins.	ES5 mins.	ES7.5 mins.	HS35 ^{o}C	HS40 ^{o}C	HS45 ^{o}C	Cont.	Mean
Baghdad1	68.6	76.6	72.6	76.3	78.6	78.6	60	73
Babylon 113	60.5	66.1	68	80	77	78	74.8	72
Mean	64.5	71.3	70.3	78.1	77.8	78.3	67.4	72.5
L.S.D (5%)	L.S.D (V)= 0.248			L.S.D (T)= 0.456		L.S.D (V*T)= 0.657		

Impact both treatments in general (positive or negative) difference in plant height as shown in Table-3 there was significant differences between treatments in their effects on plant height . Maximum plant heights was 78.3 cm obtained in Hs 45 ^{o}C (Heat shock at 45 ^{o}C) and Hs 35 ^{o}C (Heat shock at 35 ^{o}C) was 78.1 but no significant difference between them. Compared to Es 2.5 minutes (Electric shock for 2.5 minutes) was the lowest value of plant height 64.5cm. The reduction in seedling height is due to the changes in hormonal levels such as auxins and ascorbic acid: physiological and biochemical disturbances [23]. This agree with [11] showed that electric shock (until M5) reduced plant height of soy bean.

Results indicated that Baghdad 1 variety gave a maximum plant height rate 73 cm, followed by Babylon 113 varieties 72 cm. The variation in plant height among varieties may be corresponded with phenotypic difference as a result of different genotypes [24]. This is consistent with [25].

And also shows a significant interaction between (varieties X treatments), interaction between (Babylon 113 X Hs 35 ^{o}C) gave the highest value of plant height was 80 cm, compared to the interaction between (Babylon 113 X Es 2.5 minutes) was the lowest value of plant height 60.5 cm. The difference in plant height as the status of plant height governed by genes as quantitative genetics, or shock may be induced in many physiological processes.

Spike length (cm):

Table 4- Effect of electric shock and heat shock on spike length (cm) of two wheat varieties.

T / V	ES2.5 mins.	ES5 mins.	ES7.5 mins.	HS35 ^{o}C	HS40 ^{o}C	HS45 ^{o}C	Cont.	Mean
Baghdad1	11.5	12.3	10.1	14.3	12.3	14.6	9.6	12.1
Babylon 113	10	16.7	11.6	13.3	14.6	16.1	14.5	13.8
Mean	10.7	14.5	10.8	13.8	13.4	15.3	12	12.9
L.S.D (5%)	L.S.D (V)= 0.275			L.S.D (T)= 0.514		L.S.D (V*T)= 0.728		

Data in Table-4 showed treatments highest spike length was observed in Hs 45 ^{o}C (Heat shock at 45 ^{o}C) was 15.3cm. Compared with another treatments. While the Es 2.5(Electric shock for 2.5 minutes) gave lowest spike length was 10.7 cm. The difference between varieties in their response to shocks, may be due to their differences in the degree of stability of DNA [13,26].

As for varieties in response for treatments, the Babylon 113 variety was marked significantly by giving the highest spike length was 13.8 cm, while Baghda 1 was 12.1 cm, these results were in agreement with [13] Found that different genotypes gave different responses to periods of ES.

As shown in the same table, the interaction between varieties X treatments was significant, interaction between (Babylon 113 X Es 5 minutes) and (Babylon 113 X Hs 45 ^{o}C) gave highest spike length 16.7 cm, 16.1cm respectively. Whereas the interaction between (Babylon 113 X Es 2.5 minutes) resulted the lowest spike length 10 cm. The reason for this variation might be due to that genotypes differ in most vegetative traits [21].

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