WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES

SJIF Impact Factor 6.041

Volume 5, Issue 4, 483-490 Research Article ISSN 2278 – 4357

ALLEVIATION OF WATER DEFICIT CONDITIONS ON THE CORN (*ZEA MAIZE* L.) BY USING GIBBERELLIC ACID AND PROLINE.

Mustafa R. Al-Shaheen*[1,2], Awang Soh[2], Muaiad Hadi Ismael[1] and Rabah S. Shareef[3,2]

[1]Department of Field Crop, College of Agriculture, University of Anbar, Anbar, Iraq.

[2]School of Bioprocess Engineering, University Malaysia Perlis, Perlis, Malaysia.

[3]College of Education-Al-Qiam, University of Anbar, Iraq.

Article Received on
13 Feb 2016,

Revised on 04 March 2016,
Accepted on 24 March 2016

DOI: 10.20959/wjpps20164-6359

***Correspondence for Author**

Mustafa R. Al-Shaheen

Department of Field Crop, College of Agriculture, University of Anbar, Anbar, Iraq.

ABSTRACT

The current study focuses on the use of plant growth regulators, namely, gibberellic acid and Amino acids, namely proline with the goal of finding ways to cope with water scarcity and understanding the physiological adaptations of corn plants to drought using such growth regulators and Amino acids. A field study was conducted from March 2014 to June 2014 to investigate the influence of different concentrations of gibberellic acid (0, 50 and 300ppm) and proline (0, 100 and 300 ppm) to reduce effect of water stress on some physiological characteristics of corn (*Zea maize* L.) under different irrigation levels (25%, 50% and 75%). Compared with that in the untreated plants,a considerable improvement was observed in the growth and yield of the corn plants sprayed with different concentrations of gibberellic acid and proline. Specifically, a clear increase was noted in t the number of days to flowering, plant height (cm) and leaf area index (LAI) of the corn plants sprayed with proline (300ppm) and gibberellic acid (300ppm) under water stress irrigations. Corn plants positively responded to the spraying of proline and gibberellic acid and showed high drought tolerance. The corn plants were more tolerant of drought when sprayed with 300 ppm proline and 300 ppm gibberellic acid. The use of gibberellic acid and proline is an innovative and promising way to reduce the impact of drought on plant growth and crop production.

KEYWORDS: Water Stress, Proline, Gibberellic acid, Corn Growth, Irrigation Level.

INTRODUCTION

It was referred previously to the effective role of gibberellic acid and proline by increased the growth and yield characters for corn. It has been examined individually the bilateral interaction between the factors (gibberellic acid and proline) as well as the examination the triple interactions between gibberellic acid and proline under water stress conditions to find out the role of proline and gibberellic acid united to increased the plant's resistance to the water deficit thereby raising the productivity of corn. It was found that the gibberellic acid enhances the root growth, shoot growth, shoot dry weight and accumulation of protein, carotenoids and tissue nitrates in the corn.[1] Many workers have reported stimulation of endosperm metabolism by the addition of exogenous gibberellic acid.[2] has described the dependence of increase in dry weight, starch hydrolysis and protein release in excised barley endosperm in the presence of added gibberellic acid. Observed the changes in various chemical components such as sugars, proteins, lipids and nitrogen without exogenously applied gibberellic acid. The significant increase in the vegetative characteristics such as plant height as a result of the sprayed by proline due to the positive function in osmotic potential regulation by organizing pressure potential and water potential which increases the susceptibility of the cell to withdraw water from the growth environment and then increase plant growth and sustain the cell elongation and sustain the opened stomata and photosynthesis. Moreover, the fact that the proline is a source of nitrogen it contributes to building the protein and it plays a role in energy equipped to the plants.[3]

METHODOLOGY

Site of the study

This study was conducted at the Agrotechnology Research Station, University Malaysia Perlis Padang Besar, Perlis, Malaysia from March 2014 to July 2014.

Preparation of soil for planting

The field was plowed and divided in preparation for planting. The pilot units measured 2 m × 2 m each and spaced 1 m apart. Each pilot unit and its replicate were spaced 1.5 m apart. Recommended quantities of NPK fertilizer were added to the soil before planting. Soil samples were collected from the field before planting the corn seeds in different areas at a depth of 30 cm. The samples were then analyzed using standard methods to determine their physical and chemical properties (Table 1). The corn seeds (seedling length of 10 cm) were planted in small bots using media culture (Patmos) for a week and then planted in the field.

The seedlings were planted in rows (spaced 50 cm apart) and between plots (spaced 25 cm apart). Each plot with an area of 4 m was composed of six planting rows.

Experimental fields

A split-plot design based on a randomized complete block design with three replications was employed in this study. The factors included irrigation in the main plot at three levels (25%, 50% and 75%) as well as optimum irrigation (no-stress irrigation). The sub-plot was sprayed with gibberellic acid and proline at three concentrations(0,100,200 (mg \g -1) proline) and (0, 50, 100 ppm). Irrigation treatments were stopped for 15 days and then restarted with delay. The irrigation was then carried out at constant intervals.

Characteristics of the study

1.The Number of Days to Flowering.

To observe the seedling emergence daily, two inner rows were selected from each plot, starting from two days after sowing. The same rows in each plot were kept under examination, plant flowering in each plot and mean days to flowering were noted.

2- Plant height (cm).

Plant height is measured from the soil surface until the flag leaf on average of ten plants were taken randomly centrism lines each experimental unit.

3- Leaf area index (LAI).

Calculated according to the equation mentioned in Montgomery (1911) and as follows:

$$\mathbf{LAI} = \frac{\text{Rate of Leaf area per plant}}{\text{Space it be the plant Operated}}$$

Which the proportion of area for the green flat leaf to the land area occupied by the plant.

DISCUSSION

1. The Number of Days to Flowering

The results in Figure.1 explain the bilateral interaction between gibberellic acid and proline. It showed the excellence the interaction (0ppm proline and 300ppm gibberellic acid) with the highest rate of the number of days until flowering reached (**124**) with a significant difference from other interactions followed by the interaction (100ppm proline and 300ppm gibberellic acid) at a rate of the number of days reached (**123**) with a significant difference when compared with other interactions, except the first interaction (0ppm proline and

300ppm gibberellic acid) while it was recorded that the lowest rate for the number of days at the interaction (300ppm proline and 0ppm gibberellic acid) followed by the interaction (300ppm proline and 50ppm gibberellic acid) with a significant decline when compared with other interactions, except the interaction (300ppm proline and gibberellic acid 0ppm) These results are consistent with.[4][5]

The previous results indicated to a clear effected for the proline by shortened the growing season and stimulate the plant to accelerate the flowering, while the gibberellic was acid affected opposite of proline where it stimulate vegetative growth, increase leaf area and plant height, therefore, delay the flowering the interaction between proline and gibberellic acid an incentive to accelerate the flowering plant at the same time increase the leaf area and plant height and increase products of the photosynthesis process this overlap in the conditions availability of soil moisture very useful for plant and it needs more examination.[6]

The results of the triple interaction between irrigation levels and gibberellic acid and the proline showed that the outweigh of the interaction (25% of field capacity and 300ppm gibberellic acid and 0ppm the proline) with a highest rate of the number of days to flowering reached (**124**), while it was recorded that the lowest rate of the number of days to flowering at interaction (75% of field capacity and 0ppm gibberellic acid and 300ppm proline) reached (**110**) These results are consistent with.[7]

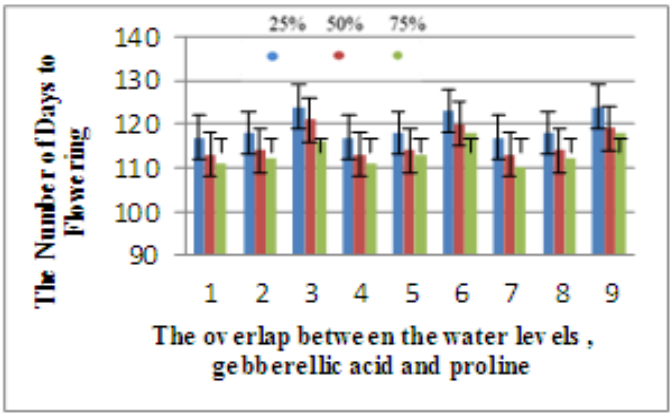

Figure.1 Effect of spray gibberellic acid and proline at different concentrations (ppm) on the number of days to flowering under different irrigation levels.

2- Plant height (cm)

The results of the statistical analysis that appear in the Figure (2) showed a significant influence of the interaction between the sprayed gibberellic acid and proline of interaction

between them on the plant height. The results of the interaction between gibberellic acid and the proline showed the superiority of interaction (300gibberellic acid and 300proline) with the highest rate of plant height reached (**210cm**), while it was recorded that the lowest rate of plant height when plants that have not been sprayed by gibberellic acid and proline (control). Followed by interaction (0 gibberellic acid and 100 proline) in the slightest rate of plant height reached (**166cm**) compared with plants that have been sprayed with proline and gibberellic acid. It showed from the previous results demonstrable of the effect of interaction between the gibberellic acid and proline on the plant height.[8]

It has been shown from the results was recorded in a Figure (2) the impact of the triple interaction between levels of irrigation and sprayed gibberellic acid and proline on the maize leaves to excellence the interaction (25% of field capacity and 300 gibberellic acid and 300proline) in the highest rate of plant height was (**210cm**) with a significant difference from the other interaction. While the lowest rate was recorded for plant height at plants that have been treated with interaction (75% of field capacity and 0 proline and 0 gibberellic acid) reached (**142cm)** these results are in line with.[9]

The results of the interventions indicated that the sprayed gibberellic acid and proline it has contributed to increased plant's resistance to drought, the proline contributed effectively in the osmotic balance in the plant cell, While the gibberellic acid has helped to increase cell division and increased the productivity of the plant.[10]

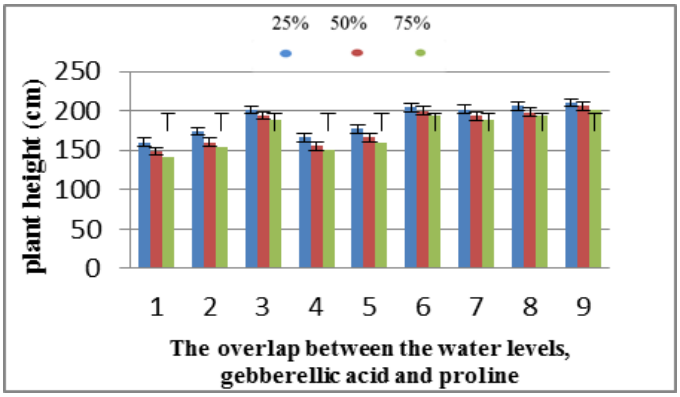

Figure.2 Effect of spray proline and gibberellic acid at different concentrations (ppm) on the plant height(cm) under different irrigation levels.

4- Leaf area index (LAI)

The results of the study indicated that the existence of a significant effect of the interactions between gibberellic acid and proline in the yield and productivity of maize,

where the results indicated in the Figure(3)to superiority of the interactions (300ppm gibberellic acid and 300ppm proline) in the highest rate of leaf area index reached (**3.92**)with a significant difference when compared with other interactions, while the lowest rate of leaf area index were recorded in the plants that have not been treated by gibberellic acid and proline (control). Discriminate the interaction (50ppm gibberellic acid and 100ppm proline) at a rate of leaf area index was (**2.59**) with a significant rise when compared with the control treatment while showed a significant decrease when compared with other treatments that have been sprayed gibberellic acid and proline. The conclusion from the results that the gibberellic acid and proline together affect clearly to increase the leaf area these results are in line with.[3]

Showed of conclusions presented in the Figure(3) the effect of the triple interaction between irrigation levels and gibberellic acid and proline on the leaf area index for maize. Found from the results outweigh the interaction (25% of field capacity and 300ppm gibberellic acid and 300ppm proline) with the highest rate of leaf area index with a significant difference from the other interactions except the interactions (50% of field capacity and 300ppm gibberellic acid and 300ppm proline) which has given rate of leaf area index (**3.92**) with an insignificant difference when compared with the first interactions. It was recorded the lowest rate of leaf area index at the interactions (75% of field capacity and 0ppm gibberellic acid and 0ppm proline) where it was recorded rate of leaf area index reached (**1.68**) with a significant decrease from the other interactions. The previous results indicated the effective contribution of gibberellic acid by increased the leaf area and cell elongation. Proline also had an active role in increasing the plant resistance to water stress.[11]

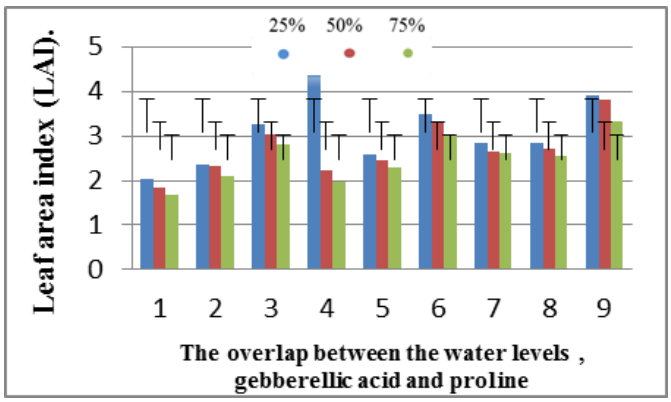

Figure. 2 Effect of spray proline and gibberellic acid at different concentrations (ppm) on the Leaf area index (LAI) under different irrigation levels.

CONCLUSION

Corn plants positively responded to the spraying of proline and gibberellic acid and showed high drought tolerance. The corn plants were more tolerant of drought when sprayed with 100 ppm proline and 2000 ppm gibberellic acid. The use of proline and gibberellic acid is an innovative and promising way to reduce the impact of drought on plant growth and crop production.

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