

Effect of Drought Stress on Leaf Chlorophyll in Corn Cultivars (*Zea mays*)

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Abstract: To measure the relationship between chlorophyll stress resistances in experimental maize cultivars Using 5 Maize genotypes in four replications and with two irrigation and dry farming conditions in a randomized complete block design in the 2010-2011 agricultural years in Ardabil region was carried out. To calculate the amount of stress tolerance of genotypes has been used of Fernandez stress tolerance indexes. And the chlorophyll content of leaves with the CCI-200 device was measured. The results showed that stress-resistant genotypes with higher potential yield and chlorophyll content were more than half resistant cultivars. According to the results of genotypes BC678 and BC404 have a highest chlorophyll index and the amount of yield and the most resistant genotypes to the drought.

Key words: Chlorophyll content • Stress resistance • Corn

INTRODUCTION

Maize crop plays an important role in the world economy and is valuable ingredient in manufactured items that affect a large proportion of the world population [1]. The most serious non-alive stress factor is that limits the growth and crop production [2]. The pigments can be destroyed by drought [3], thus causing damage by water shortage to the photosynthetic device [3].

Chlorophyll and higher carotenoids with stress tolerance in plants is associated [4].

Chlorophyll fluorescent measuring is a relatively new technology that in recent years to study the effects of different stresses including drought, salinity and temperature on photosynthetic efficiency (or yield) of leaves in the farm (or field) and greenhouse conditions convention is used [5].

Climate changes in recent decades, leading to a decrease in the rainfall amount and distribution of it in the arid and semi arid regions of the world including the Middle East.

So it seems according to the patterns of occurrence of drought changing, changing the appropriate strategies for reducing the difference between actual yield and yield potential of crops in these areas is necessary [5].

Factors That Affect the Amount of Chlorophyll Are:

- The light intensity in the amount of leaf chlorophyll and even different chloroplasts array has an effect within the cell. Chlorophyll of the shadow-friendly plants is more of the amount of light-friendly plants chlorophyll.
- The temperature is involved in the chlorophyll efficiency or its yield. So that in the plants which have the four carbon at a temperature from 30 to 45°C and in the plants with three carbon at a temperatures from 10 to 25°C, the chlorophyll has the best yield.
- The age of leaf with its chlorophyll content is directly related. Since the beginning of leaf emergence until its full growth, photosynthetic growth rate is increased and then gradually decreases.

Yellow and old leaves due to loss of chlorophyll lose their photosynthetic power [6].

The water in Synthesis of chlorophyll is very important. After a heavy rain the amount of chlorophyll is increased, but in the arid time its value decreases. On the other hand, if the soil is water saturated, leaves chlorophyll content decreases. Leaf water content to maintain the maximum amount of chlorophyll should be high [7]. In the green plants chlorophyll tissue under

Environmental stress in leaves of susceptible cultivar is decreased, but increased in the resistant cultivar and resistant cultivars leaves are to the susceptible cultivar has a darker green color. Rapid loss of chlorophyll in cold-sensitive cultivars is caused to decrease photosynthetic activity. Several environmental factors on plants are caused chlorosis or yellowing.

Chlorophyll is one of the basic pigments of plants that it's reduction of concentration causing chlorosis, growth reduction and the yield [8].

Morgan [Quoted by 6] reported that plants under environmental (peripheral) stresses lose their green chlorophyll tissues. Known that environmental stresses in terms of chlorophyll degradation have the similar effects on plants. In 1969, the chlorophyll measurement method was proposed and passing light of the extract of under heat stress leaves was compared. Terbea [Quoted by 6] of this technique for evaluation of sunflower hybrids and inbred lines used.

Also Zaeifzade and Goliov [9], reported that resistant cultivars have more chlorophyll. They with the study of the relationship between genotype and environmental conditions (drought and normal) on the amount of chlorophyll content and the amount of superoxide desmiotaz reported that in the drought resistant cultivars with increasing the drought stress, superoxide desmiotaz increases. So that in susceptible cultivars this approach showed a significant increase or decrease of chlorophyll of super oxide desmiotaz SOD.

This study for evaluating the effect of drought stress on the leaf chlorophyll in maize genotypes in Ardabil region has conducted.

MATERIALS AND METHODS

The Experiment to study the relationship between leaf chlorophyll content with drought tolerance of maize lines using 5 cultivars of maize (Table 1) in a randomized complete block design in four replications and two full irrigation and drought stress on crops in the region of Ardabil in 2010-2011 was carried out.

Table 1: Genotype names used in test

NO.	Genotype
1	Single cross 704
2	ZP677
3	BC582
4	BC666
5	OS499

Manually using seeds in five rows with 50 cm of each other in 2 m length were sown. Area of each plot was equal to 4 meters. Immediately, after planting the farm was irrigated to saturate the soil moisture profiles in the developed zone of the root and based on all treatments to be the same and in addition germination easily done. Chlorophyll content of the flag leaves with a chlorophyll meter device CCI-200 which manufactured by Opti-science company was measured. This device is measuring the Chlorophyll content index of leaves.

For variance analysis of the measured traits were used of the average data, obtained from each plot. Analysis of variance of the obtained data using the statistical software MSTATC was done. Due to lack of significant differences observed between the blocks being consistent of them, analysis of variance based on a complete randomized block design experiment was carried out. For Comparison of the test, the data obtained from the multi domain Duncan's comparison test was used. And the Excel software was used for charting.

RESULTS

The analysis of variance (Table 2) showed that the except of the chlorophyll rate of repetition the rest of sources was significant that indicates the genetic diversity of the considered genotypes and differences in their seed potential. The average index of chlorophyll content in full irrigation conditions was 60.2 and 43 in the drought conditions. Corn genotypes were tested in terms of chlorophyll content index of leaves, showed 1% significant differences in the possibility level.

The Comparison of genotypes (Figure 1) showed that in the full irrigation, genotype No. 1 with 75.1 had the highest chlorophyll than other genotypes; but genotype NO. 5 with 54.3 in stress condition was hight, Genotype 2 while with 48 in irrigation conditions has the lowest amount of chlorophyll, but but in stress condition Genotype NO. 4 with 32 was lowest. Shao *et al.*, [Quoted by 6] stated that making chlorophyll stops in the severe water shortages. In the arid conditions, often enzymes activities (such as nitrate reduction enzymes) are reduced.

Table 2: Analysis of variance results for the chlorophyll yield figures

S.O.V	df	MS	
		Yield	Chlorophyll
Replication	3	**	-
condition	1	**	**
Genotype	4	**	**
G×C	4	**	**
Error	12	0.089	13.43

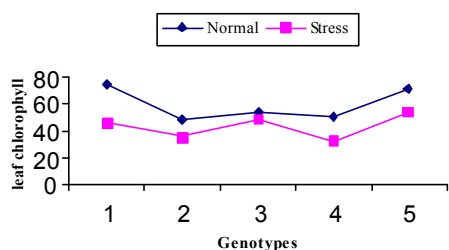


Fig. 1: The Comparison of leaf chlorophyll content of cultivars in terms of normal and stress conditions

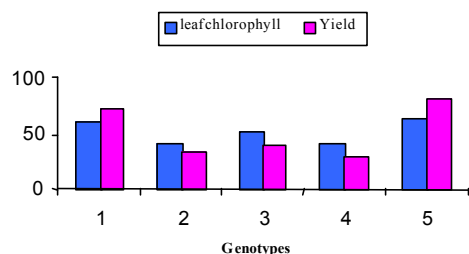


Fig. 2: The chart of interaction between chlorophyll and yield

For unifying the yield data and chlorophyll content yield data for graphing the yield data was multiplied in 10 and plotted the amount of chlorophyll interaction and yield diagram (Figure 2). According this chart, Genotypes 1 and 5 had the greatest amount of chlorophyll and yield.

DISCUSSION

Shahriari [10], stated that in the plants under the drought stress, the green tissues of chlorophyll in leaves of resistant cultivars are showing the increase. According to these results, it can be concluded that in the cultivars 8 and 10 which were the most stress tolerant cultivars, chlorophyll levels were increased and caused to a more stress tolerance of these cultivars and ultimately to obtain the most yield of these two cultivars. Sydaq *et al.*, [Quoted by 6] stated that due to changing patterns of drought occurrence during the plant growth, high yield and the stability of its under the soil water deficit, the best way is the selection of drought tolerant cultivars. So according to this theory both the genotypes 8 and 10 are selected according to their high yield. Khazaei [Quoted by 6] has expressed that the water deficit stress has the different physiological effects on the plant that the type and amount of damage depend on the stress intensity and plant resistance. So if the chloroplast of leaves was damaged, the plant photosynthesis cannot be done and will be lost, according to this selection can be useful for researchers based on these attribute.

So it seems in Genotypes 1 and 5, the resistant genes to drought exist and they can be used in breeding programs for the drought resistance.

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