Environmental stress factors and their role in plant breeding

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Plant stress is one of the abiotic stress factors among the most prominent determinants of crop productivity in many countries of the world. This does not mean that the stress of the plant to the living factors (biotic) is a little, but that the greatest decrease in productivity in general is caused by non-living stress on the plant. The selection of plants of different crops for their domestication is based mainly on the ability of those plants to bear stress factors and their rate of productivity under conventional farming conditions.

At all stages of its growth, the plant is exposed to varying degrees of environmental stress, and each stage has its impact.

The emission of gases (chlorofluorocarbons = CFC'S) from the stratosphere, which is located after the troposphere layer, and the effect of erosion of the ozone layers and the so-called greenhouse effect has its role in reducing the productivity of many crops in the world. Also, agriculture in marginal areas and the use of poor quality water for agriculture made The effect of salinity and salinity is another important factor in reducing the productivity of the crop as a result of the stress that this causes on the growing crop plant. However, what molecular genetics offers regarding the transfer of certain genes from one crop to another has opened new horizons in breeding new varieties with better tolerance to various stress factors such as Nutrient deficiency, increased salinity, drought, harmful minerals and high temperatures, as well as plant tolerance to diseases, bush plants and others. The most important non-living stresses faced by the productivity of different crops:

Water stress: water stress means the lack of good water available for absorption by the plant at any stage of its growth. The water tension does not mean that only the lack of sufficient water for the plant, but it is also affected by the presence of salinity, high temperature, freezing, toxic elements and others. Plants possess mechanisms (mechanisms) that make them live in these conditions and give a certain productivity according to the degree of tension and complete their life cycle. This depends on the genetic nature of the crop variety, the degree of stress to which it is exposed, and the stage of its growth. As well as the so-called reactive oxygen and various proteins that have an important role in most of the processes of bearing the types of tension.

Salt stress: It is one of the types of environmental stresses that have a clear negative impact on the life of plants growing in a saline environment, whether the soil is saline or the irrigation water contains high salinity.

The causes of salinity can be summed up in four points:

Using poor quality water for irrigation that contains salt. .١

The lack of effective drainage systems to drain the .٢ accumulated salts from irrigation, even if the water quality is good.

Salts are collected at the root zone as a result of the high heat .٣ that leads to intense evaporation, so salts are collected, with no irrigation or rain.

Sea water enters the irrigation of some coastal areas in the .٤ world by mixing it with fresh water or by alternating irrigation.

Soil salinity leads to:

١. Impeding the absorption of some elements, as the absorption of phosphorous, potassium, nitrate and calcium is reduced.

٢. The ion poisoning of the cell is mainly caused by Na+, -Cl, SO4-2.

٣. Increasing the osmotic tension reduces the absorption of water and dissolved substances by the root.

Low temperature tightening: Low temperature affects the increase in the viscosity of cell juice, modifications of the walls (membranes) of proteins, as well as changing the shape of proteins and the consequent changes in the type and quantity of enzymes formed in the plant. Some plants may tolerate chilling (frost), but the freezing of the cell juice at lower temperatures leads to the formation of ice crystals inside the cell, destroying its wall, damaging the cytoplasm and its contents, then the cell dies. This state of endurance varies according to the species (species), the stage of growth, the degree of temperature drop and the duration to which the plant is exposed. Among the phenomena that occur during extreme cold, the plant produces Reactive Oxygen Species = ROS compounds, which negatively affect many compounds, and this process occurs in plants, animals, and humans. Its oxidation will form free radicals that do not naturally serve the growth of the organism. ROS formation increases under cold tension and with increasing radiation intensity.

Heat stress: High heat stress suffers from most living organisms from bacteria, viruses, fungi, plants, even animals and humans. These proteins have different groups called families, and each of them has certain characteristics and functions. High temperatures cause aggregation and denaturation of proteins, and this leads to the death of plant cells.

ABA stress hormone: Abscisic acid (ABA) is an acid that acts like a plant hormone. Plants produce this acid naturally under good growing conditions, but the production of ABA increases significantly when the plant is exposed to stress conditions, and thus the production of ABA is a trigger for the occurrence of the stress state.

Oxidative stress: The role of oxygen in a plant is like its role in other living organisms. It has a basic and harmful circulation. The basis for respiration and the necessary oxidation processes. As for the harmful thing, it is that continuous exposure to oxygen leads in cells to the formation of compounds called (Reactive Oxygen Species = ROS) that leads to this. To the transformation of some compounds from a useful state of the cell to a non-useful state.

Toxic metals tension: Toxic metals are defined as metals with a density higher than 5 g.cm3. From a biological point of view, this definition does not give the required picture about the role of heavy metals in plant life (although this phrase “heavy metals” shows in agricultural and environmental research It is usually used to describe metals that are toxic because they cause bad biological reactions. Originally, it was used to refer to metals such as lead and mercury. The atomic mass of lead is 207.2gmol-1, and its specific weight is 11.34. And lily "200.59 gmol-1 and 13.55, and therefore they are Heavy in every sense of the word, but this term is sometimes applied indiscriminately, but it is unusual to find a list of heavy metals that includes elements such as aluminum, whose atomic mass is 1–26.98 g mol, and its specific weight is 2.70, in addition to semi-metals such as arsenic. So, apart from language and semantic problems, there is no chemical justification for determining which minerals should be included in this category.)

A limited number of these minerals has the ability to dissolve inside the cell, and thus it is one of the elements ready to enter into certain processes in it. Among the minerals that are good for plant life are Fe, Mo, Zn, Ni, Cu, V, Co and Cr, but they become toxic if they reach a certain limit in the cell. As for other elements such as As, Hg, Pb, and U, their role is unknown in the life of the plant and they cause phytotxic problems. Several recent researches have stated that to estimate the risk of accumulation of heavy elements is a reference to the reference concentration of the element to be estimated. The most important of these indicators are:

First: Geo accumulation index (I-Geo)

- $\boldsymbol{I - Geo = Log_2 \left(\frac{Cn}{1.5Bn}\right)}$

Cn is the percentage of heavy metals concentration in river sediments.

Bn = geochemical reference value recorded in the Earth's crust

is used for possible changes in the recorded data due to ١،٥ = petrographic differences.

I-Geo ≤ 0 (grade 0), unpolluted;(غير ملوثة)
0< I-Geo ≤1 (grade 1), slightly polluted; (ملوثة بعض الشيء)
1< I-Geo ≤ 2 (grade 2), moderately polluted; (ملوثة بشكل معتدل)
2< I-Geo ≤3 (grade 3), moderately severely polluted; (ملوثة بشكل معتدل)
3< I-Geo ≤4 (grade 4), severely polluted; (ملوث بشدة)
4< I-Geo ≤5 (grade 5), severely extremely polluted; (شديدة التلوث)
I-Geo > 5 (grade 6), extremely polluted. (.ملوثة للغاية)

Table 1-The average concentration of heavy metals was considered as the background value

Elements	Pb	Cu	Ni	Mn	Co	As	Zn
Background value	20	45	68	900	20	13	74.2

Second: Contamination factor (CF)

The level of sediment contamination with minerals is expressed in terms of pollution factor (CF) and is calculated as follows: C_F=C_meteal/C_Background

C_meteal = concentration of a specific metal in river sediments

_Background Metal focus background = $C_{Background}$

$C_F < 1$ Low contamination

$1 \leq C_F < 3$ Moderate contamination

$3 \leq C_F < 6$ Considerable contamination

$C_F > 6$ Very high contamination

Third: The Pollution Load Index (PLI)

- The pollution load index (PLI) is obtained as concentration factors (CF). (PLI) is calculated by getting the square root of the nCF obtained for all metals.
- Total Pollution Load Index (PLI), which is as follows

: $PLI = n\sqrt[2]{(C_{F1} \times C_{F1} \times C_{F1} \ldots \ldots \ldots C_{Fn}}$

where C_F1 = pollution factor

number of metals = n

The PLI value of > 1 is polluted, whereas <1 indicates no pollution.

Potential Ecological Risk Index (E_r^i) It is calculated from the following equation: $E_r^i=T_r^i \times C_f^i$

C_f^i = pollution factor

T_r^i = is the toxic response factor for a specific heavy metal according to Hakanson pb, cu, Ni, Mn, Zn, As: 5,5,5,1,1,10 and 5 respectively

The potential environmental hazards (E_r^i) of heavy metals are categorized into five levels

According to E_r^i

<40 ....low.
40-80..................... moderate.
80-160 ....moderate to high.
160-320...................... High .
$\geq$ 320.......................very high .

There are a number of indicators as well from which we can distinguish

Pollution damages:

Accumulation of toxic substances in the plant. •

Changing the degree of reaction (pH). •

Decrease or increase the activity of certain enzymes. •

An increase in the compounds bearing the SH group and • phenols.

Low levels of ascorbic acid in the leaves. •

Low rates of photosynthesis. •

Stimulating the breathing process. •

Low production of dry matter. •

Changes in permeability and disturbances in the water balance. •

Reduce fertility under prolonged exposure. •

Disruption of metabolic processes, which results from severe • damage with non-reversible effects, and the plant shows a process of decreased productivity.

Low yield. •

Low quality. •

The composition of the wood will change. •

Dry branches will appear and the tree will die gradually. •

Germination of seeds has been used by a number of operators to monitor responses to pollution and take a number of growth parameters such as:

germination percentage

seedling survival

seedling height

dilatation of cotyledons

Take dry weight and wet weight as parameters to know the response of plants to a specific pollutant

Therefore, when the plant is exposed to one of the abiotic stresses such as salinity, drought, etc., many changes occur in the plant, including chemical, biological, physical and molecular variations.

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