

Supplementary Materials

Table S1: Vegetation responses to different abiotic and biotic stresses.

Type of stress	The factors responsible for stress	Symptoms –plants reactions to stress	Mechanism of survival under stress conditions	Reference
Stress resulting from drought	When the rate of transpiration exceeds the speed at which the roots are absorbing water, or when there is inadequate rainfall and poor soil moisture quality	<ul style="list-style-type: none"> -Decreased development of seedlings and germination of seeds -Reproductive growth is severely affected - Reduction in stomatal conductance. - Reduction in the total dry matter -Limited nutrients interaction -Lower levels of photosynthesis 	Plants restrict the quantity and size of their leaves, growing the amount of lateral roots and root hair, and closing their stomata.	[1,2]
Heat stress	Caused by high temperature	<ul style="list-style-type: none"> -Decreased plant development and growth -Plant tissue dehydration -Variations in the amount of chlorophyll -Poor establishment of seedlings -Leaf margin drying and scorching effect - Reduced plant growth -Affects pollen development adversely -Variation in the process of photosynthesis -Sterility in spikelet, flower 	<ul style="list-style-type: none"> -Physical modifications inside the plant's body and by the production of signals that alter metabolism; -Maintaining rates of CO₂ uptake and leaf gas exchange; Modifications in the lipid content of membranes, transpirational cooling, or leaf orientation; reducing the absorption of solar radiation 	[1,3–5]

Stress due to salinity	Caused by Sodium (Na ⁺) and chloride (Cl ⁻) ion accumulation, naturally occurring salinity—as a result of salts building up over decades via means of organic activities in the groundwater or soil, erosion of rocks and lateral rise of brackish groundwater); Salinity stress caused by human actions that alter the hydrologic equilibrium of the soil between water applications (i.e. using low-quality water, deforestation, excessive fertilizer and irrigation dosages, and improper soil preparation procedures)	<ul style="list-style-type: none"> -Impact on reduced chlorophyll content, hypertonic stress, limited aeration, permeability of the soil and water conductivity, and soil health; -Reduced lipid and energy production, protein synthesis, and photosynthesis -Decreased rate of leaf surface expansion; decreased rate of shoot growth and the capacity of plants to absorb water 	<ul style="list-style-type: none"> -Modification of various types of proteins (ion transporters, signal proteins, and energy metabolism-related proteins); -Closure of the stomata, reduction of the CO₂ assimilation; decrease in growth metrics; rise in the loss of electrolytes 	[6,7]
Chemical stress – stress from heavy metals	Resulting from the discharge of sewage and industrial waste; traffic, heavy metal production; natural causes such as fire in forests, particles, and volcanic activity; production of energy	<ul style="list-style-type: none"> A reduction in the plants' resilience to biotic and abiotic environmental stimuli, as well as modifications to their growth pattern, chemical composition, and antioxidant defense capacity ;chlorosis and a reduction in the size of the leaves, reduced tiller count, shortened internodes (2annual2ng), and spikelet sterility, death of shoot apices 	<ul style="list-style-type: none"> -Apoplastic suberin barrier development in the roots; plants trigger a variety of specific processes for metal detoxification; interactions with other organisms such as mycorrhizal fungus that stores metals; -Plants alter the rhizosphere's pH to prevent the accumulation of metal ions; generating a lot of a particular type of root exudate etc. 	[7,8]
Cold stress	Depends on the climate and on additional factors	A number of phenotypic signs, such as decreased leaf growth, withering, and chlorosis (leaf yellowing), which	Avoidance of low temperature, Plant dormancy, Modifications in morphology, biochemistry, and biophysics; activation of some enzymes connected to	[9,10]

		might result in necrosis (death), low germination	the metabolism of sugar and the calvin cycle	
Stress caused by an excess of water	Caused by a salinity-high soil or drought, when the amount of water available to their roots is limited or when the rate of transpiration increases;	-Decrease in the oxygen diffusion rate in the soil and a build-up of hazardous substances, variations in nutrient absorption	<ul style="list-style-type: none"> -The formation of adventitious Roots, formation of aerenchyma, hypoxia avoidance strategy by increasing the supply of oxygen to the root tissue, -Reduced water absorption and closure of stomata, erosion, denitrification of soils, -Growth occurs in the root-to-shoot ratio, maximizing their cells' and organs' shape, physiology, and metabolism. 	[10,11]

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