



IMPACTS OF WEATHER STRESS ON CROP STRESS AND PLANT PHYSIOLOGICAL RESPONSES

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Introduction

Agriculture has always been closely linked with weather. Farmers carefully observe clouds, wind, temperature and rainfall because these factors decide the success or failure of a crop. Climate variability has increased the frequency of heat waves, droughts, floods and unseasonal rains, making farming more uncertain in recent years. When crop shows poor growth or yield loss, it is considered as the crop is under stress. However, the stress does not come directly from the weather alone. There is a clear difference between weather stress, which originates from the atmosphere and crop stress develops within the plant. Understanding this difference helps farmers, extension workers and students to manage crops more efficiently and reduce the yield losses under changing climatic condition.

Weather Stress Driven by Atmospheric Conditions

Weather stress refers to the physical atmospheric constrain due to extreme temperatures (heat or cold), severe weather events (storms, hurricanes), or even subtle changes like humidity, affecting mood, cognition and physical health. It refers to unfavorable atmospheric conditions that affect crops from outside. These stresses arise due to changes in temperature, rainfall, wind, humidity and radiation. High temperature during summer heat waves, low temperature and frost during winter,

drought due to prolonged dry spells, excess rainfall causes flooding and water logging, hot, dry winds, high humidity encouraging pests and diseases, hailstorms and cyclones, unseasonal rains during flowering or harvest weather stress is external and unavoidable. However, not all-weather stress immediately damages the crop. Crops possess natural tolerance mechanisms that allow them to withstand mild or short-term stress. For example, sorghum and pearl millet tolerate drought better than rice, while wheat tolerates cool weather better than maize. This shows weather stress alone does not always result in crop damage.

Plant Physiological Response to Crop Stress

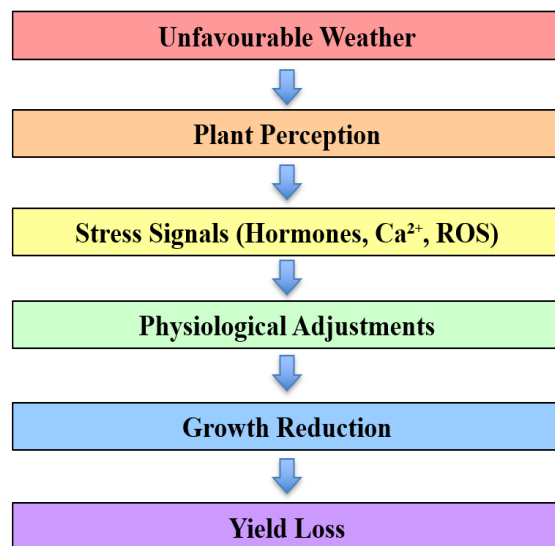
Crop stress is any adverse condition (like drought, heat, pests or poor nutrients) that hinders a plant's normal growth and reduces yield. It is categorized as abiotic (non-living factors like water, temperature, salinity) or biotic (living factors like diseases, insects, weeds). Plants respond to slow growth, closing stomata or dropping parts to conserve energy but managing these stressors through irrigation, nutrients or stress-reducing products is crucial for healthy crops. It develops inside the plant when weather conditions exceed its tolerance capacity. At this stage, the plant's normal physiological activities are disturbed. Reduced photosynthesis, increased respiration, loss of water balance, impaired nutrient uptake, hormonal imbalance, reduced

growth and yield are common physiological response to weather stress.

External Forcing and Internal Response

Weather stress represented as external atmospheric force acting on crops, whereas crop stress considered as internal physiological and biochemical response. All forms of crop stress originate from weather stress but not every weather stress event result in crop stress. Effective crop management practices such as irrigation, nutrient management, mulching and altered sowing dates can delay, buffer or reduce the effects of stress.

Conversion of weather stress



Visible Symptoms of Crop Stress

Farmers can recognize crop stress through field observations like Leaf rolling in maize and rice during drought, wilting in vegetables under high temperature, yellowing of leaves under cold or nutrient stress, flower drop in cotton and tomato during heat stress, poor grain filling in cereals, root decay under waterlogging. These visible signs indicate internal physiological disturbance (Table 1).

Table 1. Major crops affected due to weather stress

S. No.	Crop	Weather stress	Crop stress
1.	Rice	high night temperature	reduces grain filling
2.	Wheat	terminal heat stress	lowers yield
3.	Cotton	waterlogging	root suffocation
4.	Banana	cold stress	leaf yellowing
5.	Pulses	moisture stress	reduces pod formation

Managing Crop Stress in the Field

Although the weather cannot be controlled, crop stress can be managed through timely irrigation and proper drainage, mulching to conserve soil moisture, balanced nutrient application, use of stress-tolerant varieties, adjusting sowing dates, windbreaks and shelter belts, small interventions at the right time can significantly reduce yield losses.

Climate Change and Increasing Crop Stress

Climate change has increased the frequency of heat waves, intensity of rainfall events, duration of drought periods. As a result, crops experience stress more frequently and during sensitive growth stages. Understanding the plant response is essential for developing climate-resilient agriculture.

Conclusion

Plants may not express pain or discomfort, but they constantly sense and respond to their atmospheric environment. Weather stress originates from the atmosphere, while crop stress develops within the plant when

tolerance limits are crossed. Recognizing this distinction allows farmers to intervene at the right time, reduce losses and improve crop resilience. In a changing climate, understanding how plants feel the atmosphere is not just scientific knowledge, it is a necessity for sustainable farming and food security.

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