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Abiotic Stresses and Their Management in Vegetable Crop Production

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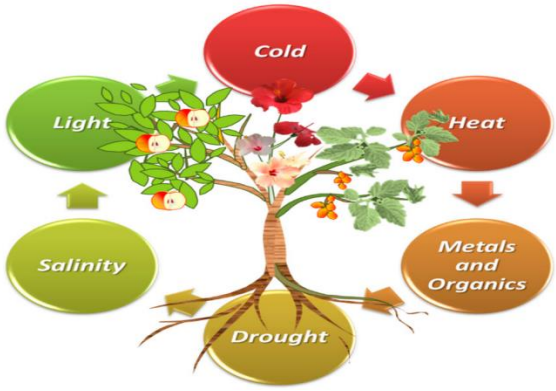
ARTICLE ID: 01

Crops are increasingly commonly subjected to abiotic stressors in today's climate change scenarios. Abiotic stress, such as drought, salt, and severe temperatures, which typically cause main crop losses around the world, are predicted to produce a yield loss Advances in Plant Defence Mechanisms 2 of more than 50% in agricultural crop plants. We should also focus on increasing the food production and supplies by two-fold till 2050 so as to fulfil the requirement and demand of human population. This can be achieved by a basic comprehension of mechanisms underlying abiotic stresses. It is for this reason that development of stress tolerant plants has received gotten a lot of attention in recent years for these reasons. During production, processing, storage, and distribution, harvested vegetables might be subjected to a variety of abiotic stressors. When there is a moderate or severe abiotic stress, quality losses nearly always occur at market. Moreover, there are abiotic stressors which ultimately decreases the defence mechanisms of plants and increases their susceptibility to infection by pathogens. Understanding the nature and origins of abiotic stressors that impact vegetables is critical. As the best way to solve these issues is to focus on both pre-harvest and postharvest abiotic stress reduction, it's crucial to understand the relationship between pre-harvest and post-harvest abiotic stresses that occur during vegetable crop production and handling, storage, and distribution, respectively.



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Prominent stress conditions in vegetable production

Temperature extremes:

Plants are vulnerable to low temperature stress if the temperature dips below 15°C, and high temperature stress if the temperature rises over 45°C. Plants are affected by high temperature stress in a variety of ways, including physiology, biochemistry, and gene regulation mechanisms. High temperatures during the reproductive period of plants can increase senescence, diminish fruit set and lower yield. Furthermore, temperature stress makes the plant vulnerable to pests and other environmental issues besides limiting or preventing seed germination, depending on the species and stress level. Exposure to high temperatures throughout the growing season might also affect antioxidants in vegetable crops. Susceptibility to postharvest chilling injury can be exacerbated if the pre harvest temperature causes chilling induced harm in the field. As a result, the magnitude of the pre harvest temperature extreme will determine whether the exposure has a favourable or negative impact on postharvest stress sensitivity.

Drought:

We know that a third of the world's population resides in areas that are having water-stress condition which may become more severe due to increasing carbon dioxide concentrations in the atmosphere. The climatic changes are therefore more expected with severe droughts in future. Water scarcity is expected to remain a major abiotic issue influencing worldwide crop output. Reduced canopy absorption of photosynthetically active sunlight,

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decreased radiation-use efficiency, and reduced harvest index are all effects of soil moisture deficit on crop output. Drought Abiotic Stresses and their management in vegetable crop production circumstances during the development of vegetable crops are becoming increasingly common as a result of climate change patterns. In root crops, field water deficiency (stress) has been found to have both positive and negative effects. Water stress prior to harvest (Irrigating to 25–75 percent of soil water field capacity) may weaken the cells, resulting in increased membrane leakage (cell damage) and, as a result, more weight loss in storage for root crops like carrots. In response to mechanical stress such as bruising potato cells undergo de compartmentation resulting in black spot conditions. Water stress, especially during the tuber-forming stage, can make potatoes more susceptible to the black spot condition after harvest.

Light:

Tomatoes grow smaller when cultivated in low light environments, such as early spring in northern latitudes, and because the ratio of surface area to volume is higher in smaller fruits, vulnerability to postharvest desiccation stress increases. It has been reported that when lettuce is cultivated under less intense lights, due to a smaller number of photons, photosynthetic efficiency as well as quality traits like vitamin C is suboptimal and thus decreasing shelf life after harvest.

Salinity:

Excessive quantities of soluble salts in the soil water (soil solution) are known as saline soil, and they can significantly affect plant growth, resulting in lower crop yields and even

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plant mortality in extreme cases. Salts are substances that dissolve into ions, such as NaCl, MgSO4, KNO3, and sodium bicarbonate. Electrical conductivity (ECe), exchangeable sodium percentage (ESP) or sodium adsorption ratio (SAR), and pH of soil paste (saturated) extract are used to calculate it. As a result, saline soils have saturated soil paste extracts with an ECe of more than 4 dSm−1, an ESP of less than 15%, and a pH of less than 8.5 [9]. Tomato crop grown in high salinity generate smaller fruits with a greater soluble solids content. It is a matter of understanding that fruits having smaller size have more surface area than their volumes (Known as Surface-area to Volume ratios), making them more vulnerable to postharvest water loss (desiccation stress).

Flooding stress:

Crops are also subjected to severe physiological stress as a result of sudden inundation following heavy rainfall events. Plants must adapt to a distinct, but equally challenging, flooding environment that occurs in a more regular cycle of seasonal fluctuations in river levels and concomitant slow flooding of crop lands. Waterlogging is the term for soil condition when there is flooding that creates hypoxia which also affects stems causing wilting with other physiological conditions.

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Plant nutrition:

When plants are unable to complete the reproductive stage of their life cycle due to a shortage of mineral components, they are considered essential. In several crops, calcium supplementation during production has been associated to postharvest issues. Calcium has been proposed as a possible signalling molecule involved in the development of abiotic stress cross tolerance. As a result, the effect of pre harvest calcium Advances in Plant Defence Mechanisms nutrition on postharvest stress resistance is likely to be multifaceted, and it will depend on whether the vegetable is also exposed to abiotic environmental difficulties. Pre harvest nitrogen levels are frequently linked to poor postharvest vegetable quality. Excessive nitrogen fertilization causes large zinc and aluminium accumulations in cabbage, as well as nitrate-induced manganese deficiency. Nitrogen fertilizer affects black spot susceptibility in potatoes. Nitrogen deficit or lower-than-recommended nitrogen treatment rates, on the other hand, will almost always result in higher vitamin C concentration in plants. Vitamin C concentration has been connected to storage life potential, which is likely due to the antioxidant nutrient's usefulness in preventing oxidative damage, which leads to quality losses in storage. Potassium deficit in carrots is linked to increased weight loss during storage. At potassium levels below 1 mM in the soil media, weight loss was directly linked to increased membrane leakage (i.e., damaged cells) in carrot tissues.

Drought, excessive watering, severe temperatures, salt, and mineral toxicity all have a negative impact on the growth, development, yield, and quality of vegetables on and off the farm until they reach the customer. Furthermore, climate change has introduced new environmental variables that may influence the vulnerability of vegetables to postharvest stress. Crop management can have a substantial impact on stress susceptibility. Adapting horticulture crops to changing surroundings could be the single most essential action we can take to prevent climate change's negative consequences.