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Abiotic Stress in Vegetables

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ABSTRACT

Vegetables are naturally very sensitive, they are impacted by a variety of biotic and abiotic stresses. Abiotic stress is defined as any negative impact that non-living substances have on living organisms inside a certain ecosystem. The severe events of climate change, such as heat stress, water stress, drought, heavy rainfall, salinity, etc., have a significant impact on the productivity and production of vegetable crops. The numerous nutrients included in vegetables assist to reduce the risk of a number of ailments, including diabetes, blood pressure, cancer, and heart disease. Since most vegetables are over 90% water, they are extremely vulnerable to climate change. The quality and yields main of vegetables are directly lowered by abrupt changes in climatic conditions, such as temperature, which impacts all phases of plant development, pollination, flowering, and fruiting. When temperatures rise to such high levels, especially when there is wind or dryness, vegetable crops like tomatoes or beans may lose parts of their flowers, which will result in a poor fruit set. Elevated temperatures can disrupt the pollination process of sweet corn, leading to corn ears that are not fully filled. Cucurbits, the family that includes squash and pumpkins, usually grow largely male flowers under high temperatures, therefore few fruits are produced.

INTRODUCTION

Abiotic stress is the result of non-living elements adversely influencing living things within a particular ecosystem (Imran *et al.*, 2021). The physiology of an organism or the performance of a population can be significantly impacted by non-living variables, which need the environment to be altered beyond its typical range of fluctuation. Abiotic stress factors, also called stressors, are

different from biotic stress factors, which are things like harmful insects or fungi that cause disturbances in the environment. Abiotic stress factors are intangible, naturally occurring forces like strong winds or sunshine that may harm the plants and animals in the affected region. In actuality, abiotic stress cannot be avoided. Abiotic stress affects both animals and plants, although plants are more constrained due to their greater dependence on their surroundings. Abiotic stress is the most harmful factor impacting crop growth and production worldwide. Additionally, research has shown that the most harmful times for abiotic stressors are when certain combinations of abiotic stress factors are present. Abiotic stresses are related to the natural environment and vary in duration and spatial extent (Andreotti *et al.*, 2020). Climate change presents great challenges to humanity and severely limits the ability of the horticulture industry to exist. Developing strategies to meet the growing population and increased demand for horticulture products such as fruits and vegetables is imperative. Climate models predict that warming will occur over the coming decades regardless of the actions taken now. The single most crucial thing we can do to prepare for the issues we face today and in the future is to produce horticultural crops that can endure abiotic stress (Garg, Shaifali *et al.*, 2017).

CLIMATE CHANGE EFFECTS ON VEGETABLES

Two major signs of climate change that have a big influence on horticulture and agriculture in general are rising temperatures and shifting rainfall patterns (both in terms of quantity and severity). Increased research on abiotic stress is required because of these variables (Gruda *et al.*, 2005).

DIFFERENT KIND OF ABIOTIC STRESS

a. Heat stress

Heat stress is defined as a temperature rise above the threshold level for a specific amount of time, which harms the growth and development of plants. Plant physiology can be greatly impacted by temperature variations because every species has an ideal temperature for development. (Hatfield and Prueger, 2015).

Effect of heat stress on germination, vegetative growth, reproductive growth

Crop	Temperature Range	Effect	References
Carrot	15° C	Reduction in germination percentage of seed and seedlings vigour.	(Besma and Mounir 2010)
Cabbage	>32 ° C	Reduction of leaf expansion including leaf length and width, decrease in fresh and dry weight.	(Rodríguez *et al.,* 2015)
Chilli	>35 ° C	Flower drop.	(Harel *et al.,* 2014)

MITIGATING STRATEGIES FOR HEAT STRESS

1. **Choosing heat-tolerant cultivars:** There are several heat tolerant varieties in tomato (Pusa sadabahar, Pusa hybrid-1), Radish (Pusa Chetki), Carrot (Pusa Vristi), Cauliflower (Pusa Meghna).
2. **Application of Growth Regulators :** The use of ascorbic acid, abscisic acid, γ-Aminobutyric Acid (GABA), Brassinosteroids, Citric acid, Glycine betaine, Nitric oxide, Salicylic Acid.
3. **Application of microbes:** AMF (Arbuscular mycorrhizal fungi).
4. **Application of inorganic amendments:** Calcium, Zinc, Sulphur and Silicon.
5. **Utilizing organic amendments:** Biochar along with Phosphorus.
6. **Use of Anti-transpirant:** Kaolin.
7. **Soil management techniques:** Mulching, crop rotation, modifying nitrogen supply and sowing dates.

Effect of Drought on Plant Development

Crop	Effect	Reference
Tomato	Susceptible to water stress during fruit setting, 25-50% yield reduction.	Patanè *et al.,* 2011
Legume	Flower drop, reduction in pod number, seed abortion.	Fang *et al.,* 2010
Bean	short shoots, short pods smaller leaves.	Durigon *et al.,* 2019

MITIGATION OF DROUGHT STRESS:

- **Choice of varieties:** Growing of drought tolerant varieties like Arka Vikash (Tomato), Arka Lohit (Chilli), Arka Kalyan (Onion), Kufri sheetman (Potato), Sree Bhadra (Sweet Potato).
- Seedling production through improved method with reduced root damage.
- Using soil and moisture conservation techniques such as zero tillage and mulching.
- Use of drip irrigation for direct application in the root zone.
- Application of foliar nutrition enhance rapid nutrient absorption.

SALT STRESS

EFFECT OF SALT STRESS ON PLANT DEVELOPMENT

Effect	Reference
Hinder growth and productivity as it can disrupt various vital processes like germination, nutrient balance, and photosynthesis, reduce seed imbibition and inhibit germination	Parihar *et al.,* 2015

MITIGATION OF SALT STRESS

1. Varieties selection of vegetable crops:
2. Black beauty (Brinjal), Golden acre (Cabbage), Pusa Madhura (Musk melon), Pusa Sawani (Okra).
3. Soil Reclamation to combat salinity and sodicity.

4. Fertilizer application through irrigation water, or fertigation.
5. Maintenance Leaching for long-term land use with irrigated vegetable crops.

The following abiotic stresses have an impact on vegetable crops:

a) Drought – *Capsicum annuum*, *Cucumis melo*, *Solanum lycopersicum*, *Allium cepa*
b) Heat – *Pisum sativum*, *Solanum lycopersicum*, Beans, Capsicum
c) Salinity – *Cucumis melo*, *Pisum sativum*, *Allium cepa*
d) Flooding/ excess moisture – *Solanum lycopersicum*, *Allium cepa*, *Capsicum annuum*

CONCLUSION

Abiotic stresses are a major cause for concern regarding the security of the global food supply. The current state of knowledge almost completely limits the quest for solutions to the massive abiotic stress caused by climate change and other variables. It has been shown that GE is valuable in helping plants become more resilient to a variety of abiotic stresses. Its primary advantage is that GE can cross the species barrier. A lot of effort has to be done in order to fully exploit the newest technologies.

REFERENCES

Andreotti, C.2020.Management of abiotic stress in horticultural crops: Spotlight on Biostimulants. Agronomy.10, 1514; doi: 10. 3390/agronomy10101514.

Besma, B.D. and Mounir, D. 2010. Biochemical and mineral responses of okra seeds (*Abelmoschus esculentus* L. variety Marsaouia) to salt and thermal stresses, Journal of Agronomy, 9(2): 29-37.

Durigon, A., Evers, J., Metselaar, K. and Lier, Q.D.J.V. (2019). Water Stress Permanently Alters Shoot Architecture in Common Bean Plants, Agronomy, 9: 160

Fang, X., Turner, N.C., Yan, G., Li, F. and Siddique, K.H.M. 2010. Flower numbers, pod production, pollen viability, and pistil function are reduced and flower and pod abortion increased in chickpea (*Cicer arietinum* L.) under terminal drought,

Garg, Shaifali (2017) "Role of work stress and coping strategies of employee Performance: An Empirical study with reference to private university employees"., IARS' International Research Journal. Victoria, Australia, 7(1). doi: 10.51611/iars.irj.v7i1.2017.68.

Gruda N. 2005.Impact of Environmental Factors on Product Quality of Greenhouse Vegetables for Fresh Consumption. Critical Reviews in Plant Sciences. 24(3): 227-247.

Harel, D., Fadida, H., Slepoy, A., Gantz, S., and Shilo, K. 2014. The effect of mean daily temperature and relative humidity on pollen, fruit set and yield of tomato grown in commercial protected cultivation, Agronomy, 4(1): 167-177.

Hatfield, J.L. and Prueger, J.H. 2015. Temperature extremes: Effect on plant growth and development, Weather and Climate Extremes, 10: 4–10.

Imran, Q.M.; Falak, N.; Hussain, A.; Mun, B.-G.; Yun, B.-W 2021. Abiotic Stress in Plants; Stress Perception to Molecular Response and Role of Biotechnological Tools in Stress Resistance. Agronomy, 11, 1579.

Journal of Experimental Botany, 61: 335–345.

Parihar, P., Singh, S., Singh, R., Vijay Pratap Singh, V.P. and Prasad, S.M. 2015. Effect of salinity stress on plants and its tolerance strategies: A review, Environmental Science and Pollution Research, 22: 4056–4075.

Patanè, C., Tringali, S. and Sortino, O. 2011. Effects of deficit irrigation on biomass, yield, water productivity and fruit quality of processing tomato under semi-arid Mediterranean climate conditions. Sci. Hortic., 129, 590–596.

Rodríguez, V.M., Soengas, P., Alonso-Villaverde, V., Sotelo, T., Cartea, M.E., Velasco, P. 2015. Effect of temperature stress on the early vegetative development of Brassica oleracea L, BMC plant biology, 15(1), 1-9.