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Techniques for mitigating the impact of heat waves on the Kharif crops in the South-western region of Haryana

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A heat wave is an extended period of extremely hot weather, especially in countries with an oceanic climate. It may also be accompanied by high humidity. Although definitions differ, a heat wave is defined in relation to the local average temperature as well as the typical weather for the season. Temperatures that people from a hotter climate consider normal can be termed a heat wave in a cooler area if they are outside the normal climate pattern for that area.

Within the global context of climate change, there is a projected rise in the frequency, severity and duration of intense heatwaves. Summer heatwaves are becoming more frequent, intense and longer in duration when the global surface temperature rises in a warmer environment.

Addressing rates of rise at both the regional and global levels in the spatial spread of heatwaves. As per IPCC report, there are certain evidences which shows the rise in global temperature which includes; nine-fold rise in the number of IPCC regions that have experienced heatwaves at the same time over the past forty years. The number of heatwaves worldwide has increased eight-fold after 2000. The world's food security and population are seriously threatened by (spatially compound heatwaves) SCHs, which also have a 50% chance of reducing crop yields. Planting and harvesting seasons have been severely impacted by the sustained heatwave that has been made worse by the climate crises. It is a part of a pattern where summers are arriving sooner and the monsoon is arriving later. For example, because of the late planting season, wheat was still growing during the heatwave, with reduced production. The global food chain will be under increased stress due to climate change.

An essential sign of how the terrestrial ecosystem will react to heatwaves is the status of the vegetation. Heatwaves typically have an impact on vegetation development by reducing mesophyll, stomatal conductance, and enzyme activity as a physiological reaction to high temperatures and water deficits. For instance, the majority of the decline in vegetation gross primary output can be attributed to soil moisture deficits brought on by summer heatwaves. Consequently, it is essential to evaluate how summer's record-breaking heatwaves affect the growth of vegetation.

How does heat waves impact agriculture?

Heat waves can have significant and often detrimental effects on agricultural crops. It increases an unnecessary strain on the water resources in the impacted areas by raising the

demand for irrigation water. Common repercussions include decreased crop yields, droughts, enhanced insect and disease pressure and degraded soil. The impact of extreme heat events on agriculture is multi-faceted, affecting plant physiology, soil conditions, water availability, and ultimately crop yield and quality. Here are some of the key effects represented in Figure-1.

Specific Crop Impacts

- **Cereals (e.g., wheat, maize, rice)**: Sensitive to high temperatures during flowering and grain filling stages, leading to poor grain set and lower yields.
- **Fruits and Vegetables**: High temperatures can cause sunscald, reduce fruit set and lead to poor fruit quality.
- **Legumes (e.g., soybeans, beans)**: Heat stress during flowering can lead to flower drop and poor pod set, reducing yield.

Several strategies to mitigate the effects of heat waves on crops

Heat waves pose significant challenges to agriculture, particularly during the Kharif season in regions like South-western Haryana. To effectively manage the impacts of heat waves, a combination of proactive measures and adaptive practices is essential. Managing the effects of heat waves on Kharif season crops in the South-western regions of Haryana involves several strategies that focus on both immediate and long-term measures. Here are some effective ways to manage these impacts.

1. Selection of Heat-Resistant Crop Varieties

- **Heat-Tolerant Varieties:** Adoption of crop varieties that are specifically bred for heat tolerance. These varieties can withstand higher temperatures and provide better yields under heat stress conditions.
- **Drought-Resistant Varieties:** In addition to heat tolerance, choosing drought-resistant varieties can help crops survive periods of low rainfall, which often accompany heat waves.

2. Improved Irrigation Practices

- **Efficient Irrigation Systems:** Implement drip or sprinkler irrigation systems to ensure precise and efficient water use. These systems help maintain soil moisture and reduce water wastage.
- **Scheduled Irrigation:** Schedule irrigation during the cooler parts of the day, such as early morning or late evening, to minimize evaporation losses and stress on plants.

3. Soil Management:

- **Mulching:** Apply organic mulch (e.g., straw, leaves) around plants to retain soil moisture, reduce soil temperature, and prevent weed growth.
- **Soil Conditioning:** Enhance soil structure and water-holding capacity by incorporating organic matter and using soil conditioners like gypsum.

4. Crop Management Techniques:

- **Staggered Sowing:** Stagger the sowing times to spread the risk of heat stress. This way, not all crops will be at the same vulnerable stage during a heat wave.
- **Intercropping:** Practice intercropping with heat-tolerant crops to create a microclimate that can reduce the overall temperature and provide shade to sensitive crops.

5. Use of Shade and Protective Structures:

- **Shade Nets:** Use shade nets or row covers to protect crops from direct sunlight and reduce heat stress.
- **Greenhouses:** For high-value crops, consider using greenhouses or polyhouses to control the internal climate and protect plants from extreme weather conditions.

6. Nutrient Management:

- **Balanced Fertilization:** Ensure proper nutrient management by providing balanced fertilization. Nutrient-stressed plants are more susceptible to heat stress.
- **Foliar Sprays:** Apply foliar sprays of micronutrients and growth regulators to boost plant resilience against heat stress.

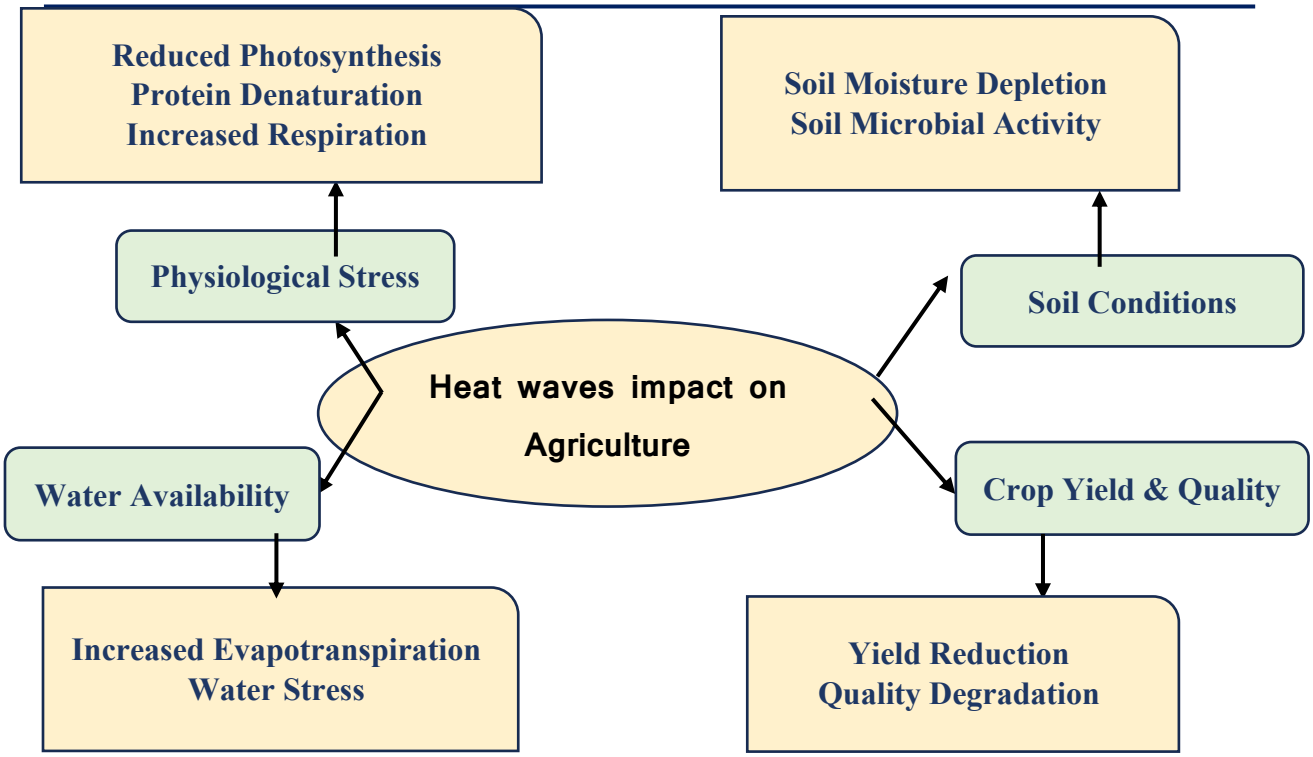

Figure 1: Impact of Heat Waves on Agriculture

7. Pest and Disease Management:

- **Integrated Pest Management (IPM):** Implement IPM practices to control pests and diseases, which can be exacerbated by heat stress and weakened plant health.
- **Monitoring and Surveillance:** Regularly monitor crops for early detection of pest and disease outbreaks, allowing for timely interventions.

8. Climate-Smart Practices:

- **Agroforestry:** Integrate trees and shrubs into farming systems to provide shade and reduce temperature fluctuations.
- **Weather Forecasting:** Utilize weather forecasting services to plan agricultural activities and irrigation schedules better.

9. Capacity Building and Awareness:

- **Farmer Training:** Conduct training programs for farmers on heat wave management practices and the adoption of new technologies.
- **Awareness Campaigns:** Raise awareness about the impacts of heat waves and the importance of adaptive measures through community outreach programs.

Conclusion

Heat waves have a direct impact on livelihood, food security and agricultural productivity. Heat waves are viewed by many scientists as a catalyst for developing cutting-edge technology and risk management plans to lessen the vulnerability imposed by climate change. Climate change has created pressure to start significant innovation processes by using effective technology and vulnerability-mitigation management techniques. By implementing these strategies, farmers in south-western Haryana can mitigate the adverse effects of heat waves on Kharif season crops, ensuring better crop health and yields.

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