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Impact of Heat Waves on Agriculture

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The earth's average temperature has been rising. Heat waves are becoming extremely intense and frequent globally. Heat waves resulted in poor vegetative and retarded growth, pest infestation like fall army and whitefly attacks and viral infections in crops and livestock. In India, the months of March and April 2022, are the warmest on record, witnessed an unusual increase in maximum and minimum temperatures over most parts of the country. During this period, the extreme temperatures were found to be higher by +8 to +10.8°C and the rainfall lower by -60 to -99%, respectively compared to normal in 10 out of 36 meteorological subdivisions. In addition, 2022 will be remembered as a classic example of coupled impact of high temperature and subdued rainfall on agricultural production systems, specifically in northern and central India. Agricultural production in India is becoming increasingly vulnerable to climate variability and change characterized by temperature rise and altered frequency, timing and magnitude of precipitation.

Favorable conditions for heat wave in India

- ✓ Transportation / prevalence of hot dry air over a region (There should be a region of warm dry air and appropriate flow pattern for transporting hot air over the region).
- ✓ Absence of moisture in the upper atmosphere (As the presence of moisture restricts the temperature rise).
- ✓ The sky should be practically cloudless (To allow maximum insulation over the region).
- ✓ Large amplitude anti-cyclonic flow over the area.
- ✓ In addition, if the soil is very dry, all the solar radiation heats this, allowing the warming of the air in contact with the soil, promoting even higher temperatures.

Causes of Heat Waves

- ✓ Anticyclones over western parts of Rajasthan (March) and absence of western disturbances (absence of rainfall) triggering early and extreme heat waves.
- ✓ Anticyclones cause hot and dry weather by sinking winds around high-pressure systems in the atmosphere.
- ✓ Heat wave (HW) is defined based on the temperature thresholds over a region in terms of actual temperature or its departure from normal.

Impacts of Heat waves

Physical impacts on Water resources Because of the close relationship between climate and water, heat wave intensifies the water crises in several regions, especially in arid and semi-arid areas. Excess water uses due to heat waves sometimes become detrimental in places suffering from water scarcity, especially in the context of climate change. In India, heat wave phenomena are silent killers as this increases the evaporation rate from the water resources.

This increases demand for water both for general use and agricultural purposes. Indirectly, sustenance of crops and farm animals become difficult during this heat wave period. Physical impacts also wild/forest life as well as energy consumption. High temperatures beyond certain optimum level reduce plant growth by affecting the shoot net assimilation rates, and thus the total dry weight of the plant is collectively termed as heat stress, which is one of the most important factors limiting crop production. In higher plants, heat stress significantly alters cell division and cell elongation rates which affect both leaf size and leaf weight. Heat stress induces changes in rate of respiration and photosynthesis and leads to a shortened life cycle and reduced plant productivity.

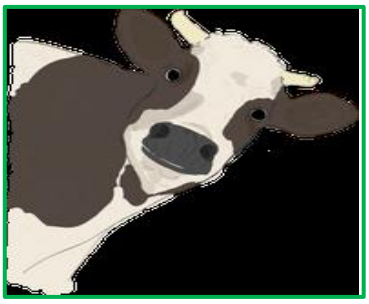
- ✓ The abnormal increase in maximum and minimum temperatures during 2022 impacted crops, fruits, vegetables and animals in the nine states of Punjab, Haryana, Rajasthan, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Bihar and Maharashtra.
- ✓ The negative impact on yield of wheat and paddy in most part of India is due to increase in temperature, water stress and reduction in number of rainy days.

Heat impact on wheat crop

- ✓ It can induce yellowing and shriveling of the grain and forced maturity.
- ✓ It may result in moisture stress, sunburn, and flower drop.
- ✓ Poor pod setting, wilting and forced maturity, flower drop and poor pollination were observed in Rabi crops like green gram, maize, chickpea, cowpea and mustard.
- ✓ They were also seen in important horticulture crops like mango, citrus, apples, plum, pomegranate, lemon, cabbage, cauliflower, cucumber, bitter gourd, tomato and okra, the report stated.
- ✓ A reduction of 23 per cent was observed in kinnow yield in Punjab.
- ✓ Chickpea in Haryana also experienced a yield reduction up to 19 per cent. In Uttar Pradesh, a temperature increase of 5°C in March from the normal resulted in flower drop and lots of jhumka (a fruiting disorder) in mango trees.

Impact of heat waves on lemon, mango and pomegranate in different districts of Rajasthan

- ✓ In Himachal Pradesh, viral infection and petal fall in both royal and spur-type apples were observed. Similarly, malformation, flower and fruit drop in mango were observed in Himachal Pradesh's Chamba, Kullu and Bilaspur districts.
- ✓ Drying of leaves and plants in guava, lemon and mango; flower and fruit drop in papaya were observed over Bhilwara and Sirohi districts of Rajasthan.
- ✓ Flower and fruit drop in pomegranate and lemon was observed in Pali district of Rajasthan.
- ✓ Under heat stress, a number of physiological and behavioral responses of livestock vary in intensity and duration in relation to the animal genetic makeup and environmental factors.



- ✓ The hot weather also increased the body temperature of livestock and milch animals by 0.5 to 3.5 degrees Celsius (°C), which reduced milk yields by 15 percent. Diary animals faced the problem of increased calf mortality and skin infection.
- ✓ Rise in temperatures also reduced egg production by up to 10 per cent during the initial two days of the heat wave. Loss of appetite and higher body temperature in milch/fowl.

How to tackle with Heat wave mitigation

- ✓ Opting for the right crop varieties, bathing animals, and adopting the mulching technique (e.g., Plastic Mulching).
- ✓ Mulching helps in maintaining the soil moisture for long period. Mulch the soil with paddy straw or locally available organic or inorganic material. Black polythene material would be essential to prevent excess evaporation. Foliar spray of 2-4% Kaolin is recommended depending on the severity to reduce the transpiration.

Mulching in orchard

- ✓ Spray of Potassium Nitrate at boot leaf and flowering stages minimised yield loss.
- ✓ Mulching in sugarcane, ridge and furrow conserved the soil moisture and minimised the stress.
- ✓ Timely sowing and adoption of heat-tolerant wheat crop varieties HPW-368, JW-3288, PBW-725, PBW03 and DBW187 in different regions

Heat waves resistant wheat variety JW-3288

Heat waves resistant wheat variety PBW-725

- ✓ Fruit trees should be cover with shade nets/cotton cloth to reduce sun scalding.
- ✓ Increase the nutrient density (primarily energy and amino acids) of diets by about 10% to compensate the reduced feed (nutrient) intake during heat stress.