

Drought Management Strategies

Senthilkumar, B. Bhakiyathu Saliha and P. Saravana Pandian

Department of Soils and Environment, Agricultural College and Research Institute,
Madurai-625104

ARTICLE ID: 13

Introduction

Low rainfall or monsoon rain failure is a recurring feature in India. The term "drought" generally refers to a region's scarcity of water. Even though aridity and drought are caused by a lack of water, aridity is a permanent climatic feature that is the result of several long-term processes. Drought is a temporary condition caused by insufficient precipitation for vegetation, river flow, water supply, and human consumption. Drought is caused by an abnormality in atmospheric circulation.

Definition of Drought

Drought has no universally accepted definition. Drought is defined by India's Irrigation Commission as a situation in which annual rainfall is less than 75% of normal rainfall. A relevant definition of agricultural drought appears to be a period of dryness during the crop season that is long enough to reduce yield. The extent of yield loss is determined by crop growth stage and stress level. It does not begin when the rain stops, but rather when the plant roots are unable to obtain soil moisture quickly enough to replace evapotranspiration losses.

Major Terms Related to Drought

1. Relative drought: A drought situation for one crop may not be a drought situation for another. This is due to a mismatch between soil moisture and crop selection. As an example: A condition may be a drought situation for growing rice, but it may not be a drought situation for growing groundnuts.

2. Physiological drought: High osmotic pressure of soil solution due to increased soil concentration, as in saline and alkaline soils, causes crops' inability to absorb water from the soil even when water is available and not because of a lack of water.

Major Causes of Drought

Inadequate precipitation, erratic distribution, long dry spells in the monsoon, late monsoon onset, early monsoon withdrawal, and a lack of proper soil and crop management.

Periodicity of Drought

The Indian Meteorological Department examined the incidence of drought from 1871 to 2021 and concluded the occurrence of 22 major droughts, with more than 40% of the total area experiencing drought in 1877, 1899, 1918, and 1972. General observations on the periodicity of drought in different meteorological sub-divisions of India, such as Assam have a very rare recurrence of drought, around once every 15 years. West Bengal, Madhya Pradesh, Konkan, Coastal Andhra Pradesh, Kerala, Bihar, and Odisha have a period of recurrence of drought once every 5 years. Droughts occurred once every three years in South interior Karnataka, Western and Eastern Uttar Pradesh, Gujarat, Maharashtra's Vidarbha region, Rajasthan, Tamil Nadu, Kashmir, Rayalaseema, and Telangana, and once every 2.5 years in Western Rajasthan.

Effect of Drought on Crop Production

Drought affects water status by affecting absorption, translocation, and transpiration. Moisture stress reduces photosynthesis by lowering the photosynthetic rate, chlorophyll content, and leaf area, and increasing assimilate saturation in leaves (due to lack of translocation). Drought reduces water content and respiration. The size of the cells and intercellular spaces shrinks, the cell wall thickens, mechanical tissue develops more rapidly, and the number of stomata per unit leaf increases. Water deficits affect almost all metabolic reactions, decreasing the activity of growth-promoting hormones like cytokinin, gibberellic acid and indole acetic acid while increasing the activity of growth-regulating hormones like abscisic acid, ethylene, and so on. Nitrogen fixation, uptake, and assimilation are affected; because dry matter production is significantly reduced, NPK uptake is reduced, resulting in decreased growth of leaves, stems, and fruits. Drought also has an impact on nutrient absorption, carbohydrate and protein metabolism, and ion and metabolite translocation. Protein breakdown, rather than protein deficiency, harms drought-stressed plants by accumulating toxic by-products of protein breakdown such as ammonia. Plant water deficits during droughts can cause leaf, fruit, and seed abscission. Maturity is delayed if there is a drought before flowering, but it advances if

there is a drought after flowering. The number of fruits and individual grain weight is determined by drought during flowering and grain development, respectively. Panicle initiation in cereals is critical, while drought during anthesis may cause pollen drying. Drought reduces yield during grain development, whereas the vegetative and grain filling stages are less sensitive to moisture stress. The effect on yield is highly dependent on what proportion of total dry matter is regarded as useful material to be harvested. The effect of drought on aerial and underground parts is as sensitive as total growth. Moisture stress at flowering is detrimental when the yield consists of seeds, as in cereals. When the yield is fibers or chemicals, and the economic product is a small fraction of total dry matter, moderate growth stress has no adverse effect on yields.

Crop Adaptations

Drought adaptation refers to a crop's ability to grow satisfactorily under water stress. Adaptation is the structural or functional modification of plants for them to survive and reproduce in a specific environment. Crops survive and grow under moisture stress conditions primarily through two mechanisms:

- 1. Drought resistance:** The ability of a crop species or variety to grow and yield satisfactorily in areas with periodic water deficits.
- 2. Drought evasion/ escape:** the ability of a plant to complete its lifecycle before serious soil and plant water deficits develop.

Strategies for Drought Management

Adjusting the plant population: In dryland conditions, the plant population should be lower than in irrigated conditions. Under dryland conditions, whenever moisture stress occurs as a result of prolonged dry spells, the plant population can be adjusted by:

- 1. Increasing the inter-row distance:** Adjusting the number of plants within the row and increasing the distance between the rows reduces competition throughout the crop's growing season.

2. Increasing the intra-row distance: The distance between plants is increased here, allowing plants to grow luxuriantly from the start. During the crop's reproductive period, there will be competition for moisture. As a result, it is less advantageous than the alternatives discussed above in conditions of limited moisture supply.

Mid-Season Corrections

Mid-season corrections are contingent management practices used in the standing crop to overcome unfavorable soil moisture conditions caused by prolonged dry spells. These practices include the following:

- 1. Thinning:** This can be accomplished by removing every alternate row or every third row, which will save the crop by reducing competition.
- 2. Spraying:** During prolonged dry spells, crops such as groundnut, castor, red grams, and others can be saved by spraying water at weekly intervals or 2 percent urea at week to 10 days intervals.
- 3. Ratooning:** Ratooning can be used as a mid-season correction measure in crops such as sorghum and bajra after a dry spell breaks.

Mulching

It is the practice of applying any covering material to the soil's surface to reduce evaporation losses. Mulches will extend the availability of moisture in the soil and save the crop during drought conditions.

Weed Control

Weeds compete with crops for different growth resources and can be a serious problem in dryland conditions. The majority of weeds require more water than crop plants. As a result, they compete for more soil moisture. As a result, weed control, particularly during the early stages of crop growth, reduces the impact of a dry spell by conserving soil moisture. Tillage Practices Mechanically manipulating land to minimize runoff and evapotranspiration.

Water Harvesting and Life-Saving Irrigation



Water harvesting is the collection and storage of run-off water during peak periods of rainfall. During long periods of drought, the stored water can be used to provide life-saving irrigation.

Other Strategies

Drought-tolerant crops with increased row spacing without affecting final yield can be identified and practiced. Adjusting the sowing dates so that the crop's reproductive stage, in addition to other critical crop growth stages, does not pass through the drought. Effective pest and disease control, as well as optimal fertilizer doses, should be ensured, and proper and recommended techniques for correcting nutrient deficiencies, should be used.

Conclusion

Drought is a significant phenomenon that occurs in agriculture, and its impact can not be underestimated because it is one of the most important entities that influence agricultural productivity, particularly in a developing country like India, where a significant portion of farming still depends on suitable climatic conditions, particularly precipitation. If not properly mitigated, it hurts plant growth both economically and physiologically, and several methodologies are used to ensure proper growth of plants/crops under stress, which include: adjusting plant populations, mid-season corrections, and other equally important strategies.