



Abiotic Stress and their Management in Pigeonpea Cultivation in Bundelkhand Region

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Pulses are rich in protein, minerals and vitamins, take part in a significant role in the nutritional security of Indian people. Pulses can adjust to a wide range of edaphic and climatic conditions and therefore can represent an important component of climate-change mitigation and adaptation strategy. Pigeonpea (*Cajanus cajan*) is one of the major legume crops of the tropics and sub-tropics region. Pigeonpea is considered as a drought tolerant crop with a large variation for maturity period and its deep root system. These variations for maturity have direct importance on the survival and vigor of the crop in different agro-ecological niches. Pigeonpea encounters various abiotic stresses during its life cycle such as moisture (water logging/drought), temperature, photoperiod and mineral (salinity/acidity) stress. One abiotic stress is frequently associated with some other stresses, making it difficult to know the correct cause of the crop failure or yield reduction. The major abiotic stress limiting productivity of Pigeonpea includes undulated topography, water logging, drought, frost, poor soil fertility. Management techniques of abiotic stresses significantly increased yield, net profit and B: C ratio as compared to farmers practice. This article delves into the importance of water management in Pigeonpea cultivation, exploring strategies and techniques adapt to the Bundelkhand region's unique climate and soil conditions.

Soils and Climatic Characteristics of Bundelkhand region

Bundelkhand region of Uttar Pradesh is a central semi-arid plateau of India that spans across seven districts in Uttar Pradesh state. Bundelkhand region consist on both sides of across Madhya Pradesh and Uttar Pradesh, 7 district of each state.

The soil of Bundelkhand region is Sandy-loam to clay-loam soils with low water-holding capacity, rainfall is low 600-800 mm annually with high evaporation rates and temperature fluctuations. While there is an impressive growth in Pigeonpea production in India it is challenged by a number of constraints which include several abiotic stresses.

Abiotic stresses

1. Waterlogging and Salinity: Waterlogging is responsible of a number of biological and chemical changes in plants and soils that can reduce crop growth in both the short and long period of time. Germinating seeds/ emerging seedlings are highly affected by waterlogging. Pulses are more sensitive to waterlogging than other crops.

Pigeonpea is a primarily rainy-season crop experiences waterlogging in high rainfall areas and soils with low permeability. Generally North-eastern Plains Zone (Uttar Pradesh, Bihar, West Bengal, Assam, and Orissa) and Central Zone (Madhya Pradesh and Maharashtra) receive high rainfall. Waterlogging situation frequently seen in rainy season in

this regions. Waterlogging check the aeration in soil, reduce the root growth, nodule formation, vegetative growth and reduce overall production. Waterlogging and salinity has been recognized as one of the major constraints to Pigeonpea cultivation.



2. Drought: Drought is the absence of rainfall for long time period and cause moisture reduction in soil and water deficit in plant tissue. In Bundelkhand region drought situation is very frequent. The inherent deep root-system of Pigeonpea imparts high degree of drought tolerance; however, moisture stresses at reproductive phase do severely limit productivity, and sometimes even no yields are realized. This stress also limits symbiotic N fixation and vegetative growth of Pigeonpea in initial days. Drought is responsible most yield reduction in all crops.

3. Heat: Heat stress occurs when the temperature are high cause irreversible damage to plant function as photosynthesis, respiration, water relations and membrane stability. Due to temperature yield reduce through flower drop and pod abortion.

4. Cold: Pigeonpea experiences low temperature stress during winter months (December–January). The stress adversely affects growth, survival and reproductive capacity of plants if the minimum temperature falls below 5°C. At freezing temperature, intracellular water gets converted into ice, which in turn causes shrinkage of cells inside the plant, resulting in wilting and death of plants.

Management practice

- A proper drainage channel should be form in the field for removing of excess water from field.
- Early sowing of Pigeonpea will be done for maximum growth and hard stem at time of heavy rainfall.
- After the water logging Use of nitrogen fertilizer in Pigeonpea for
- Windbreaks and shelterbelts reduce harmful effects of high temperature.
- Irrigation should be applied during high temperature and low temperature.
- Moisture stress, high or cold temperature tolerance varieties should be grown.
- Spray of growth retardant of 500 ppm cycocel for arresting apical dominance and thereby promoting growth of lateral branches and Foliar spray of 2% DAP + 1% KCl (MOP).
- Use of Antitranspirant for minimization of water losses during drought situation like Materials causing stomata closure Herbicides (2, 4 – D and Atrazine), Fungicides {Phenyl Mercuric Acetate (PMA)}, Reflecting Types (Kaolin), Thin-forming chemicals (Hexadecanol), Polyethylene materials forming thick films (Mobileaf).
- **Mulching:** Mulches is any material that cover surface of soil and benefits like reduce evaporation, improve water in soil, soil conservation, maintain temperature, reduce soil salinity and weed control. Apply organic mulch to retain soil moisture and suppress weeds.

Strategies to enhance production and productivity of Pigeonpea

Pigeonpea like most other grain legume crops has lost genetic variability for high yield potential traits during the process of its domestication for its survival. It is this lost variability that needs to be regenerated. Most present-day plant breeding efforts in developing high yielding varieties aim at defect elimination i.e., developing resistant varieties to biotic (Wilt, SMD, Phytophthora, Pod borers etc.) and abiotic (moisture stress, high or cold temperature tolerance) stresses. The plant of Pigeon pea, which is like a hardy plant, and survives under adverse environmental condition, with more vegetative and woody growth with less sink capacity. Systematic studies to rebuild the plant type to improve the genetic yield potential of Pigeonpea are very limited.

Summary

Pigeonpea is considered as a drought tolerant crop with a large variation for maturity period and its deep root system. Abiotic stresses severely affect the growth and development of crop. Major abiotic stress which limits the productivity of Pigeonpea includes undulated topography, water logging, drought, frost and poor soil fertility. One abiotic stress is frequently associated with some other stresses. Management techniques are designed to increase the productivity of crop and significantly increase the yield, net profit and B: C ratio as compared to other conventional farmers practices.