



Adaptive Features of Arid and Semi-arid Fruits under Drought Conditions

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Drought is a major limiting factor for growth and development in higher plants. Drought is a common occurrence in dry environments, many perennial plant species have developed mechanisms to cope with a restricted water supply. Plants can avoid drought stress by maximizing water uptake (e.g., tapping ground water by deep roots) or minimizing water loss (e.g., stomata closure, small leaves). Arid zone is characterized by extremes of temperature, low and erratic rainfall, high wind velocity, high evapotranspirational losses of water and light sandy soil with very poor water holding capacity and fertility status. Looking into the very dismal future scenario of water in arid zone, growing of less water-requiring crops with high water use efficiency is necessary. Drought-hardy crops especially perennial fruits with deep root system are capable of surviving in extreme temperatures and provide income security and nutritional security. Ber, pomegranate, custard apple, aonla, karonda, kair, khejri and date palm are the major fruit crops which are commercially grown in arid regions. The native plant species have adaptations that are capable of growing, reproducing and surviving in semi-arid, arid and even desert regions. Plants are adapted to aridity by several mechanisms that are as under.

Ber

It is a perennial hardy fruit tree which gives income from multiple products such as fruits, fodder and fuel wood even in severe drought conditions to the resource lacking farmers. It is the only fruit crop which can give good returns even under rainfed conditions. It is possible due to following mechanisms.

1. It has deep & extensive root system to draw ground water from the deeper soil profile.
2. Leaves are xerophytic in nature and the buds are scaly due to which it stands in extreme summer heat without damage.
3. Leaf shedding mechanism in adverse condition either in summer or winter to conserve moisture. In those areas where leaf shedding is not effective, plants are pruned in summer (April-May) depending upon situation to reduce the water requirement by removing leaves.

4. Flowering in ber starts with onset of monsoon & character of this dryland fruit is that it sheds its leaves completely and thus conserves moisture by evading transpiration.
5. It has also some adaptive mechanisms to cope up with dryland conditions through
 - a. Reducing in the cell and stomata size
 - b. Increased vascular bundles
 - c. Compact mesophyll cell arrangement
 - d. Low osmotic/water potential & low desiccation rate *etc.*

Aonla

It is hardy, prolific bearer and highly remunerative even without much care and can be grown in variable agro-climatic and soil conditions. Aonla bears flowering during spring, after fruit setting, fruits enter into dormancy and resume growth after onset of monsoon. Owing to such character, plants do not require irrigation during summer. Thus, it is the most ideal rainfed fruit crop.

Pomegranate

Pomegranate is an economically important commercial fruit crop of arid and semi-arid regions. It has xerophytic characteristics and hardy nature makes it suitable crop for dry, rainfed, pasture and undulating land, where other fruit crops cannot grow successfully. Pomegranate crop synchronizes with its reproductive cycle with maximum moisture availability period. However, it bears fruits during *mrig bahar* coinciding with rainy season can be encouraged if few irrigations are available.

Custard apple

It is also hardy fruit crop and tolerates drought conditions. It can be grown on shallow soils. Its flowering habit and fruit development coincide with maximum moisture availability period i.e. flowering in June-July and harvesting in September- October. Custard apple also sheds its leaves in summer to escape moisture loss from plant tissue through transpiration. Custard apple also remains dormant for a short period during cold season. This is most ideal rainfed crop completing reproductive cycle during the period of moisture availability.

Tamarind

Tamarind is one of the most important rainfed fruit crops & has deep root system. It can tolerate scorchy wind. It bears flowers with onset of monsoon and its fruits are harvested during February. It is drought resistant and tolerates temperature up to 45⁰ C. It can also be grown slight alkali and saline soils. Leaves are small which help in reducing transpiration & it sheds its leaves under certain conditions during summer.

Wood Apple

It has tap root system and possesses great tolerance to drought and salinity. The reproductive phases of wood apple synchronise with high moisture availability. Reduction in number & size of leaves and dense attachment of aerial shoot are also adaptive mechanisms found in wood apple. Owing to such features, it is suitable crop for rainfed areas. It is also an excellent tree for waste lands.

Karonda

Karonda is an evergreen spiny shrub or a small tree up to 3 m height and suitable for arid tropics and sub-tropics. It grows successfully on marginal and wastelands. The plant is also useful for making attractive thorny dense hedge around any fruit orchard. Its main flowering

season is March–April with fruits maturing during August–September which enables the plants to make best use of monsoon rain.

Bael

Bael is an indigenous hardy fruit crop and can be grown successfully in dry areas. It is well known for its nutritional and therapeutic properties. The marmelosin content of fruit is known as the panacea of the stomach ailments. Its flowering coincides with onset of monsoon and the fruits of bael mature before advancement of hot summer.

Fig

It can tolerate salinity and drought. Fruiting in fig synchronises with rainy season and the fruits are harvested in late winter. It has also some adaptive mechanisms to cope with dryland conditions through

- a. Water binding mechanism
- b. Shedding leaves during summer *etc.*

Date palm

Date palm can tolerate salinity and saline irrigation water to a great extent. For successful fruit maturation, nearly 3000° days heat unit are required. The heat units available in most of the north-western districts of India, counted from the time of flowering, *i.e.* end February to July, indicate that these are suitable for date palm cultivation.

Jamun

Jamun is successfully grown under tropical and subtropical climate. It tolerates drought conditions due to having extensive root system. It requires dry weather at the time of flowering and fruiting. Flowering starts in spring season and fruits are available in June–July after onset of monsoon. For ripening of fruit and proper development of its size, color and taste, early rains are considered very beneficial.

In addition to these, there are many indigenous drought, hardy plants which have some adaptive mechanisms. Kair has scanty foliage and mucilaginous sap in plant bodies which holds water and does not loose in summer. As Indian cherry, locally known as lasoda is another important fruit plant suitable for arid and semi-arid regions of India. Its fruits and other parts have multiple uses in human health and nutrition. This plant also offers scope in using harvested rain water for fruit production since it requires irrigation only for 2–3 months period during summer season (April–June). Phalsa has ability to complete the life cycle during the period when there is no rainfall due to xerophytic characters like wax coating and closed stomata on leaves to reduce the loss of water through transpiration. It also bears flowering in month of January and fruiting in summer season.

Conclusion

The arid and semi-arid fruits are hardy in nature. They can grow well in dry areas and can tolerate drought conditions due to adaptive characters like deep & extensive root system, shedding of leaves during summer season. Mostly, these crops have reproductive phase synchronising with moisture availability during drought condition. These are source of the sustainability of small holdings of dry areas, also provide nutritional security and have high potentials to develop wastelands widely available in the region. Therefore, these may be ideal crops for drought condition of arid and semi-arid regions.