

Dryland horticulture:

A boon to rainfed farmers

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Dryland horticulture is an approach to growing food that involves planting crops which can survive without water for at least six months or more. This means that farmers can grow their crops even when there isn't enough rainwater available to irrigate their fields. Dryland horticulture has a special significance in minimizing the risks and enhancing the productivity and income. The selection of fruits and vegetable crops vary due to rainfed agro-ecologies (rainfall and soil type). High yielding and suitable cultivars for dryland areas and their multiplication, water and nutrient management, technologies that extend shelf-life of fruits, value addition of the products and marketing are to be promoted to farmers, and fruit and vegetable growers. There is an ample scope for enhancing the resilience and income of farmers in rainfed areas through dryland horticulture.

Keywords: Dryland, Floriculture, Vegetable crops

DRYLAND horticulture has significant role especially in enhancing the per unit land productivity. At present, the productivity of these lands is very low. The cultivation of fruit crops in rainfed areas with conventional methods is not going to be a paying proposition. The yield of horticultural crops in drylands varies greatly depending on the amount and pattern of rainfall. Horticultural crops have a major role in ensuring livelihood security of farmers in rainfed areas. The recent decade has witnessed a sea change in the production of horticultural crops. Efficient management of natural resources plays an important role in improving the productivity of horticultural crops. Appropriate land use, maintaining soil fertility, efficient management of water resources and adoption of farming system approach for harnessing synergy between different components are some of the approaches on natural resource management for improving the productivity. Climate change, changing rainfall pattern and temperature, emergence of new pests and disease and depletion of natural resources pose challenges to production and productivity of dryland horticulture. Scientific approaches and adoption of appropriate dryland horticulture technologies gives good returns to farmers at farm gate.

Fruit crops for drylands

Selection of fruit crops in drylands is very important. Based on the rainfall zones and physiography, the choice

of fruit crops is given in Table 1.

Table 1. Fruit crops for drylands in different rainfall zones

Mean annual rainfall (mm)	Plains	Plateaus and sub mountain regions
>500	Kherji , Ber, Phalsa, Indian Fig, Karonda.	Custard apple, Bael, Karonda, Ber, Jamun,
500–1000	Ber, Aonla, Jamun, Wood apple, Custard apple, Guava, Sour Lime, Lemon, Mango, Tamarind, Pomegranate	Ber, Custard apple, Wood apple, Karonda, Indian Almond, Mango, Sour Lime, Lemon, Grapefruit, Pomegranate
>1000	Mango, Jack fruit, Mandarin, Tamarind, Jamun	Mango, Jack fruit, Guava, Tamarind, Cashewnut, Cherry, Pomegranate

Vegetable crops for drylands

Among the vegetable crops bittergourd, bottlegourd, ridgegourd, spongegourd, watermelon, roundmelon, longmelon, snapmelon, drumstick, cluster bean, cowpea, okra, amaranth, brinjal, chillies and tomato are commonly grown in rainfed areas.

Floriculture in drylands

Dryland areas have taken an ornamental path and paved the way to produce tuberose, chrysanthemum, crossandra, marigold, jasmine and aster along with ornamental cut flowers like rose, carnation, gerbera, tulip, liliun, alstroemeria, orchid and anthurium in the protected structures. Apart from production

and marketing of these flowers, there is a scope for commercial cultivation of flower saplings and foliage plants. The market opportunities are enormous due to their low volume and high value.

Medicinal and aromatic crops for drylands

Medicinal plants like isabgol (Gujarat Isabgol-1 and Gujarat Isabgol 2), aloe (*Aloe vera*), senna (Anand Late Selection), egyptian henbane (HMI-80-1) and palmarosa (Rosa Gross 49a), lemongrass (NLG 84) and vetiver (Hyb 8) are the aromatic plants that can be cultivated commercially under dryland conditions to generate additional income through crop diversification.

Spices for drylands

Cumin (GC 4), fennel, fenugreek (Ajmer Fenugreek-4, high yielding), till, ajwain (Ajmer Ajwain 93, early maturing), nigella (Ajmer Nigella 20) can be cultivated in

multi-story cropping system and for income generation. These spices can also be cultivated along with fruit crops for enhanced farm income.

Selection of varieties

There are varietal differences among horticulture crops for resistance to abiotic stress. Early ripening/ maturing cultivars are better stress tolerant. The popular cultivars of fruit and vegetable crops in drylands are given in Table 2.

Selection of site

It is always better to establish an orchard in a predominantly fruit-growing area than in a new locality, where few or no orchard exists. This will not only help in sharing experiences of local fruit growers, but also purchasing of plant materials, orchard

Table 2. Popular cultivars of fruit and vegetable crops in drylands of India

Crop	Cultivar
<i>Fruit</i>	
Ber	Kashmiri Red Apple, Sanaar 2, Goma Kriti, Umran, Seb, Gola, Mundia, Kaithi, Banarasi Karka and Early Umran
Aonla	Goma Aishwarya, Chakaiya, Anand 2, Kanchan, Krishna, Balawant, NA 6 and NA 7
Pomegranate	Basin Seedless, Jyothi, Ganesh, Kesari, Bhagya, P 23, P 26, IIHR Selection and Mridula
Custard apple	Myammat, Cerimoya, Balanagar, Maumoth, Red Sitaphal and Arka Sahan
Guava	Lalit, Allahabad Safeda, L 49, Sardar, Kohir Safeda and Safed Jam
Papaya	Pusa Delicious, Honey Dew, Pusa Mejesty, Pusa Dwarf and Pusa Giant
Bael	Goma Yashi, Thar Divya, Thar Neelkanth, Thar Srishti, CISHB 1, Pant Aparna, NB 5 and NB 9
Sapota	Kalipatti and Cricket Ball
Fig	Poona fig, Dianna and Excel
Mango	Dashehari, Kesar, Mallika, Badami, Raspuri, Banglora, Neelum and Bombay Green
Sweet orange	Mosambi, Kodur Sathgudi, Valencia, Blood Red and Malta
Lime	Tenali, Promalini and Vikram
Tamarind	Goma Prateek, Pratishthan, GKVK 6 and 33, Urugam DTS 2, PKM 1, Pratisthan and Yogeshwari.
<i>Vegetable</i>	
Tomato	Gujarat Tomato 1, Gujarat Tomato 2, Pusa Ruby, Pusa Early Dwarf, Pusa 120, Sweet 72, S 12, Mangala and Punjab Chhuhara
Chilli	GVC 111, GCV 121, GCV 131, Pusa Jwala, Mathania, Sindhur, Pant C 1, Arka Mohini, Arka Gauraav, Arka Basant, Bharat and Indira
Cowpea	Pusa Barsati, Pusa Naubahar, Pusa Komal, Anand Cowpea 1, Pusa Dofasli, Pusa Phalguni and Pusa Rituraj
Cluster bean	Goma Manjari, Pusa Mausami, Pusa Navbahar, Durga Bahar, AHG 13 and Pusa Sadabahar
Brinjal	Doli 5, Gujarat brinjal hybrid 1, Pusa Purole Long, Pusa Purple Round, Pusa Kranti, Pusa Anmol, Arka Shhel, Arka Kusumakar and Arka Navneet
Radish	Arka Nishant.
Pumpkin	Thar Kavi, Arka Chandan, Gujarat pumpkin 1, CO 1 and CO 2
Amaranth	Choti Chaulai, Badi Chaulai, CO 1 and CO 2
Okra	Punjab No.13, Punjab Padmini, P 7, GO 2, GO 5, Parbhani Kranti, Pusa Makhamali and Arka Anamika
Muskmelon	Pusa Sharbati, Pusa Madhuras, Hara Madhu, Punjab Suneehri and Durgapura Madhu
Water melon	Sugar Baby, Arka Manik, Arka Jyoti Kesar and Durgapur Meetha
Bottle gourd	Pride of Gujarat, Pusa Naveen, Arka Harit, Pusa Summer Prolific Round, Pusa Summer Prolific Long, Pusa Meghadoot and Pusa Manjari
Bitter gourd	Arka Harit, Pride of Gujarat and Pusa Do Mausami
Ridge gourd	Pusa Rasadar
Sponge gourd	Pusa Chikani
Round melon	Arka Tinda
Drumstick	Thar Harsha, GKVK 1, Dhanaraj, Bhagya and PKM 1
Onion	Arka Niketan, Arka Kalyan, Pusa Red, Nasik Red, Pusa Ratnar, Pusa White Round, Pusa White Flat, Patna Red and Arka Pitambar (for export).

equipment, transport, marketing, storage of fruits etc. Besides, the site for an orchard should be either as close to a consuming centre/market or well connected for transport by road or rail.

Planting

The type of soil, fruit species, and geography of the site all have a significant role in determining the planting strategy in dryland areas. Planting is typically done in a square or rectangular pattern in the plains. Fruit trees are cultivated on contour terraces, ditches and bunds, and micro-catchments on sloppy plains. Staggered trenches and bunds have been dug across the hill. Trees are planted in micro-catchments, which might be triangular or rectangular, at the lowest point where runoff gathers. In such a runoff harvesting system, the distances between the rows and the trees must be appropriately altered and controlled. The amount of rainfall, which affects runoff volume, will undoubtedly have an impact on the plant density.

Microsite improvement

Microsite improvement is essential to improve the survival of fruit tree seedlings in drylands. In shallow red soils and soils with poor fertility, micro-site improvement can considerably enhance seedling/sapling establishment and plant performance. In this technology, pits of 1 m × 1 m × 1 m are dug and refilled with a mixture of topsoil removed from the pit, sand and tank silt in equal proportion along with fertilizer supplements. Such pits have higher water-holding capacity.

Water management

The condition of the soil in the orchard, especially during the fruit growth stage, has a significant impact on the trees yield. To keep the root zone of the trees as moist as possible in drylands, strategies like rainwater harvesting and utilization, mulching, and weed control are important. By adopting *in situ* moisture conservation practices and/or *ex situ* rainwater management for runoff water harvesting, the water stored in water storage structures like farm ponds etc, can be used for life saving/supplemental irrigation to horticultural crops. The best ber yields were achieved at 0.5% and 5% slopes with 8.5 m and 7 m lengths of run, and 72 m² and 54 m² catchments area/trees, respectively at Jodhpur.



Farm pond for supplemental irrigation in orchard crops

In Hyderabad, micro-reliefs have been utilized to collect excess rainwater for fruit trees including kagzi lime, coorg mandarin, and sweet orange with tomato and okra as intercrops. These micro-reliefs are 3 m wide and 25 cm in height, spaced 9 m from ridge to ridge.

Micro-irrigation

In dryland areas, water is a precious commodity, so irrigation needs to be as efficient as possible. In micro-irrigation, water is irrigated through drippers, sprinklers, foggers and by other emitters on surface or subsurface of the land. The best type of irrigation for desert plants is a drip irrigation system. Drip lines lose less water to evaporation and run-off.

Mulching

Mulches are well known for modifying the energy and water balance at surface of soils and creating more favourable conditions for plant growth. Mulches enhance the growth and yield of crops by modifying the temperature, reducing evaporation losses, better weed control, conserving soil and improving nutrient uptake from the soil. Mulching with organic materials greatly reduces these losses apart from reducing weed development, decreasing soil erosion and enriching the organic content of the soil.



Plastic mulching in vegetable crops

Plant growth regulators

Plant growth regulators are the naturally extracted or synthesized compounds which are used in smaller quantity to modify the hormonal activity in agricultural and horticultural crops. Some plant growth regulators are used to enhance the stress tolerance of dryland horticulture crops by inducing stomatal closure, viz. abscisic acid, jasmonic acid, brassinosteroids and cytokinins.

Nutrient management of arid and semi-arid fruit crops

The fruit tree nutrition is very important for better productivity and quality. The nutrient absorption by various fruit species varies considerably (Table 3). The recommended doses of macro and micronutrients for various dryland horticultural crops are to be given in a balanced way using integrated nutrient management approach.

Table 3. Nutrient absorption by fruit trees (kg/tonne)

Fruit tree	Nutrient absorbed in the fruits		
	N	P	K
Aonla	4.3	1.7	7.3
Citrus	1.1	0.6	6.3
Date palm	4.2	2.0	9.0
Pomegranate	1.6	0.5	5.0
Ber	1.4	0.4	4.8

Interculture and weed management

Intercultural operations help in keeping the soil loose and friable and also permit the retention of moisture. Weeds are the major obstacle for efficient use of moisture and nutrients, as they compete for essential crop production factors with crop plants right from the early stage. Many preventive, cultural, mechanical and chemical weed management practices are effective in controlling the weeds.

Pest and disease management

Wild animals, rodents, birds and insects (termites) create serious problems to dryland horticulture crops. Fruit fly (*Carpomyia vesuviana*) is a serious problem in ber. The extracts of azadiractin 1% and *Ocimum sanctum* 1% combined are effective up to 10 days after spraying. Application of neem powder and tobacco leaf extracts would also significantly reduce fruit fly damage and it is used for organic cultivation of ber. Bait spray combining molasses or jaggery 10 g/l and one of the insecticides, malathion 50 EC 2 ml/l, dimethoate 30 EC 2 ml/l was given in 2 rounds at fortnight interval before ripening of the fruits. Pomegranate butterfly (*Virachola isocrates*) can be controlled by clipping off calyx cup of flowers

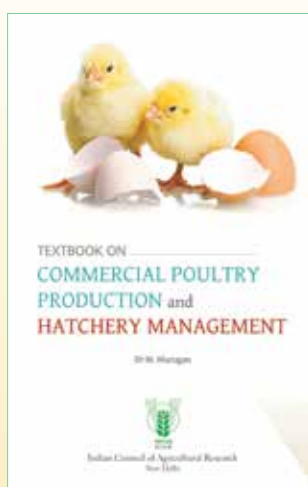
immediately after pollination which will help to reduce the egg load on the fruits and damage level. Clipping off calyx cup immediately after pollination and two rounds of spraying with neem oil at 3% also controlled pest infestation effectively. Two sprays of Emamectin benzoate 5 SG at the rate of 0.25 g/l or Spinosad 45 SC at the rate of 0.20 ml/l has recorded highest reduction in the fruit damage, with maximum benefits to the growers. Ber powdery mildew can be controlled by spraying of Dinocap 0.1% or wettable sulphur 0.2% during first and third week of November. Two sprayings of Carbendazim 0.1% at 15 days interval, starting from the time when the fruits are pea size followed by Dinocap 0.1% spray at 10–15 days interval.

SUMMARY

Dryland horticulture has a key role in enhancing the land productivity, resilience to climate variability and enhancing the dryland farmers. Selection of crops and management of agroecology specific natural resources and horticultural crops are vital for successful dryland horticulture. The dryland regions of the country have huge potential to produce fruits, vegetables particularly cucurbitaceous, solanaceous vegetables and other horticulture crops. There is a need for capacity building of the farmers in various aspects of dryland horticulture. Further, the successful dryland horticulture can be scaled out in convergence with national, state and district programmes such as National/State Horticulture Mission, Rashtriya Krishi Vikas Yojana, Prime Minister Krishi Sinchayee Yojana etc.

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