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Xeriscaping in arid climates

M. Malakar*[1], P. Acharyya[2] and R. Bhargava[2]
[1].Department of Horticulture, University of Calcutta, 51/2, Hazra Road, Kolkata- 700019
[2]ICAR- Central Institute for Arid Horticulture, Bikaner 334006
*Corresponding authors e-mail: moumitamalakar7@gmail.com
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Abstract

Xeriscape is a systematic concept for saving water in landscaped areas. Xeriscaping (zer-i-skaping) is a word originally coined by a special task force of the Denver Water Department, Associated Landscape Contractors of Colorado and Colorado State University, USA to describe landscaping with water conservation as a major objective. Even though dry-only landscaping can be quite spectacularly colorful, and even lush, limited areas of more highly watered landscape are completely consistent with wise water use. There are vast arrays of wonderful plants indigenous to all regions, non-invasive introduced plants, that are well adapted to the local regional climate, are wonderful additions to landscaping that uses water frugally. Xeriscape is not necessarily a lawn less landscaping. Some lawns, even of species that are more highly watered, can be consistent with wise water use. "Less-lawn landscaping," rather than "Lawn-less landscaping" is an appropriate statement. On the contrary, well planned Xeriscapes are splendid examples of beauty and diversity.

Key words: Xeriscaping, Xerigation, Xerimulch, Arid.

Introduction

The term "arid" has a range of connotations that vary by culture and historical period. For some, it implies barren wastelands, while for others it evokes landscapes of biological, cultural and aesthetic richness (Anon., 1986). From a scientific standpoint, aridity refers to a scarcity of moisture, in which precipitation is exceeded by potential evapo-transpiration. These varied climatic patterns of water deficit interact with physiographic conditions to produce a variety of arid and semiarid environments (Aga Khan, 1996). Due to this water is a precious resource in high desert and efficient water use is the responsibility of all residents, businesses and public agencies. States of North-western India has a wide range of climate that varies from extremely arid to humid. Desert area generally receives meagre precipitation per year and contain some of the most uninhabitable regions on earth. So the successful development of water-smart-gardening can be an exciting challenge to convert those desert regions into cool, green landscapes full of beautiful plants maintained with water-efficient practices.

Xeriscaping is commonly referred to as water-wise or water-smart gardening (Dwiggins, 1985). Conserving water conservation techniques with landscaping is a concept known as "Xeriscape" or "Dry Landscape". Xeriscaping (zer-i-skaping) is a word originally coined by a special task force of the Denver Water Department, Associated Landscape Contractors of Colorado and Colorado State University to describe landscaping with water conservation as a major objective (Jhon *et al.*,1991). The derivation of the word is from the Greek "xeros," meaning dry, and landscaping thus, xeriscaping (Wilson and Feucht, 1996). Xeriscaping combines sound horticultural practices to conserve water while maintaining a beautiful landscape. Professionals and homeowners can take an aggressive and positive attitude toward water conservation in landscape design and management. When basic horticultural principles are employed with an emphasis on water efficiency, landscapes use much less water and are drought tolerant.

Principles of Xeriscaping

The seven water-saving principles of xeriscape landscaping are not new; they have been practiced in the landscape industry for decades. Combining all seven into a comprehensive program of landscape water conservation is what makes Xeriscape landscaping unique (McLean, 1989). The principles are:

1. Planning and Design
2. Zoning Plants
3. Soil
4. Efficient Irrigation or Xerigation
5. Turf and Turf alternatives
6. Xerimulching

7. Maintenance

Each of this principle should be used while designing and managing landscape. 30 -60% water-use can be reduced if employed on this basic principles of xeriscape (Anon., 1985). In fact, a well-planned xeriscape can be attractive, colorful and very rewarding. Often it is thought that a Xeriscape means the use of all native or low water use plants, resulting in limited plant selection. However, xeriscapes can incorporate hundreds of plant choices including trees, shrubs, evergreens, perennials and grasses (Klassen and Gilpin, 1999).

Planning and Design: Creating a water-efficient landscape begins with a well-thought-out landscape design. When designing a new landscape or renovating an existing one, planning the landscape on paper is the best place to begin. The first step in planning a water-efficient landscape is selection of site followed by drawing of the lay-out of the existing building, driveway, walks and vegetation. Existing trees, shrubs and flower beds are allocated on the design. Careful notes are to be made on sun and wind exposure, topography and drainage. Relationships among all site features are to be considered. Modifications that require grading, paving or construction should be planned at this stage. Existing shade trees should be left wherever possible because shady landscapes are cooler and need less water than sunny areas. The size of the lawn area is to be decided as often lawns are the single largest user of water in the landscape, so reductions in lawn areas should be done wherever possible. Switching to a more drought-tolerant lawn species can also reduce watering needs.

The site's microclimate is to be outlined on the plan. Microclimates are areas within the design that have environmental condition that differ from the adjacent areas. It also influences the plant selection. For example, a large shade tree on the southern side will lower the temperature and mitigate water demands. Cooler shady areas on the northern side forms a good environment for shade loving plants.

Zoning Plants: The concept is to place plants with the same requirements for water, soil and sunlight into the same areas or hydrozones (watering zones) (Amy Jo Detweiler, 2005).The landscape plant can incorporate "hydrozones" areas within a design that receive either low, moderate or high amount of water. All plants within a zone have the same water requirements and can be watered as a group to make efficient use of irrigation water. Certain planting areas can be designated as low-water-use-zone having low-water requiring plants, will receive little or no extra water after their establishment. A few limited high-water-use-zones may be introduced for specimen plants as an accent or focal point. A vegetable garden or flower border may be considered for this zone. Plant varieties and placements are to be planned accordingly.

Types of Hydrozones

Hydrozone	Supplemental water requirements	Plant type (s)
Very Low	Required for plant establishment.	Most natives.
Low	Some required during growing season	Most perennials, some trees & shrubs.
Moderate	Regular amounts required during growing season	Fruit trees, ornamental trees & shrubs.
High	Regular amounts required during growing season	Turf grass, vegetable gardens.

Soil: Properly conditioned soil is of vital importance to the health of landscapes. Creating a good soil environment is the key to successful water conservation. In sandy soil, water moves quickly through the profile while in very sandy soil, water and valuable nutrients are also lost due to leaching below the root zone. In sandy soils addition of organic matter can only increase water and nutrient-holding capacity, aeration and drainage. Regardless the soil type, the general rule of thumb is to amend the native soil with 1/3 organic matter.

Xerigation: Efficient irrigation is the basis of a successful Xeriscape.

Proper irrigation practices can lead to 30 to 80 percent water savings (Christopher, 1988). Tremendous amounts of water are applied to lawns and gardens, but much of it is never absorbed by the plants. Some water runs off because it is applied too rapidly and some water evaporates from exposed, unmulched soil; but, the greatest waste of water is applying too much too often.

Lawns: Turf areas should be irrigated differently than shrub

borders and flower beds. North and east exposures need less frequent watering than south and west exposures. Most lawns receive twice as much water as they need. The key to watering lawns is to apply the water only when the grass needs it. The best types of irrigation for turf grass areas include low pressure, low angle sprinklers that provide head to head coverage. This creates a deep, well-rooted lawn that efficiently uses water stored in the soil. Wilting and discoloration are signs of water stress. At the first sign of wilting, watering should be done within 24 to 48 hours before serious injury occurs.

Trees and shrubs: Newly planted trees and shrubs once established should be watered less frequently so they develop deep roots and are able to withstand drought. For trees, shrubs, and perennials micro-sprays, drip emitters, or bubblers are used. The feeding root system of a tree or shrub is located within the top 12 inches of the soil and at the "dripline" of the plant (Swenerton,1988). Water and fertilizer are applied from just inside to a little beyond the dripline.

Irrigation systems: The irrigation system should be so designed that plants receive only the water they actually need. By zoning an irrigation system, grass areas can be watered separately and more frequently than ground covers, shrubs and trees. Sprinkler and drip irrigation can be used together to conserve water in the landscape. A permanent sprinkler system can be more water-efficient than a hose-end sprinkler, but both systems require little maintenance and apply large volumes of water in a short time. In areas where water quality is poor (i.e., high salt content), drip irrigation is safer for landscapes. There is little chance that water applied through drip irrigation will be wasted by evaporation or runoff (Springer,1994).

Now-a-days Smart Watering Application Technology (SWAT) are used for xeriscaping as it monitors and use information about environmental conditions for a specific location and landscape. This information includes soil moisture, rain, wind, the plants' evaporation and transpiration (ET) rates, and in some cases, plant type and is used to determine when to water providing exactly the right amount of water to maintain lush, healthy growing conditions (Privette,1987).

Turf and Turf Alternatives: When designing the landscape, it should be kept in mind that turf grasses need more water and maintenance than most other plants. Proper site preparation in establishing turf is essential in maintaining a healthy, water efficient lawn. To conserve water, the size of the lawn may be reduced by including patios, decks, shrub beds and

Examples of drought tolerant grass species.

Common name	Scientific name	Particulars	
Bermuda grass	*Cynodon dactylon*		Good drought tolerance; produces dense turf; poor shade tolerance; plant seed or sod.
Buffalo grass	*Buchloe dactyloides*		Excellent drought tolerance; produces thin turf; poor shade tolerance; plant seed or sod.
Centipede grass	*Eremochloa ophiuroides*		Low maintenance; tolerates partial shade; tolerates drought; plant seed or sod.
Zoysia grass	*Zoysia* spp.		Produces dense turf; good shade tolerance; good drought tolerance; plant sod.

Xerimulching:. Mulch should be used wherever possible. A good mulch conserves water by significantly reducing moisture evaporation from the soil. Mulch also reduces weeds, prevents soil compaction, and keeps soil temperatures more moderate (Gouin, 1973). The ideal application for a mulch layer is adding between two and five inches on top of the soil. If it exceeds then cutting off of the oxygen supply to the plant's root system can result in root death (Powell, 1982).

Wood and organic mulches: It allows for oxygen to get to the root system more easily than rock or stone mulches. Wood and organic mulches will also return some nutrient components back to the soil over time as it breaks down.

Rock and stone mulches: It can also be used selectively. Rock mulch will stay in place more effectively, especially in windy areas. Rock mulches also absorb more heat and may scorch the roots or leaves of heat sensitive plants. Like any other mulch, it must be selected to fit its place of use.

Maintenance: All gardens, including xeriscapes, need routine, seasonal maintenance to preserve the beauty and health of landscape. Maintenance includes pruning, mowing, watering, weeding, fertilization and integrated pest management (IPM). In general, xeriscapes require less maintenance than traditional landscapes, and even less as the Xeriscape matures (Scott,1986). A healthy, maintained landscape is also more resistant to drought, heat, freezing, disease, and insects. Winter watering is critical in a high desert environment where plant materials tend to desiccate through the winter months. Under such situatuins watering should be done to new plantings every 4 weeks when the ground is warm enough to absorb water (Robinette *et al*,. 1984). Trees, shrubs, and perennials can be fertilized once during the growing season in spring or early summer with a slow release fertilizer. Late summer should be avoided. Minimum amount of organic fertilizer can be given to turf to avoid additional water use and increased mowing as a result of too much nitrogen. Weeds have to be eliminated to prevent them from competing with desirable plants for water and nutrients. Once a weed seed bank is established, seeds can stay viable for many seasons.

Conclusion

Water is a vital concern for everyone in desert area because it is a limited and fragile resource. Many people believe that watering landscapes is a nonessential luxury. In times of severe drought, rationing may limit the amount of water we can use for our lawns and gardens (Knox, 1995). Therefore, arid or desert habitants have a special responsibility to conserve water and protect its quality. Xeriscaping conserves water in the landscape without sacrificing beauty and plant diversity. By following these principles, anyone can proudly create their own xeriscape landscape.

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Examples of drought tolerant tree species.

Common name	Scientific name	Particulars
Large Trees (above 30 feet)		
Pine, Limber	*Pinus flexilis*	Very flexible branches on this evergreen, hence the name. Needles in groups of five are bluish green. Attractive silver bark and large cones. 
Southern Magnolia	*Magnolia grandiflora*	 Large, striking evergreen tree with large, dar k green leaves up to 20 cm (8 ") long and 12 cm (4.5 ") wide, and large, white, fragrant flowers u p to 30 cm (12 ") in diameter, widely cultivated in warmer areas. The timber is ha rd and heavy, commercially used to make furniture, pallets and veneer.
Oak, Bur or Mossycup	*Quercus macrocarpa*	A handsome tree with an irregular growth habit and interesting moss - like covered acorns. Dark green leaves. Very adaptable in tough environments and long - lived. 
Golden Rain Tree	*Koelreuteria paniculata*	 Deciduous tree with a broad, dome -shaped

Small Trees (20 to 30 ft)		
Choke Cherry, Amur	*Prunus maackii*	Attractive, shiny, coppery -red peeling bark. Clusters of white flowers, followed by purplish red fruit. 
Khejri	*Prosopis cineraria*	 It is the state tree of Rajasthan, India. Leaves are bipinnate. Branches are thorned along the internodes. Flowers are small and creamy -yellow. The tree is found in extremely arid conditions, with rainfall as low as 150 mm annually; but is indicative of the presence of a deep water table. As with some other *Prosopis* spp., *P. cineraria* has demonstrated a tolerance of highly alkaline and saline environments (Huddleson,1997).
Indian Red Pear	*Protium serratum*	 It is a medium sized tree with branchlets densely yellow, velvety, grey velvety when old. Flowers light green in colour borne in densely velvety panicles in leaf axils.
Rohida	*Tecomella undulata*	It has trumpet shaped flowers and leaf margins are wavy, drooping branches with greyish brown bark, suitable for arid climate. It is an impo rtant timber -yielding plant of Rajasthan and commonly known as Marwar teak or Desert teak. 

Examples of drought-tolerant shrubs.

Common name	Scientific name	Exposure	Particulars
Dwarf shrubs (1- 3 ft.)			
Red yucca	*Hesperaloe parvifolia*	Sun	Red flowers on tall spikes. 
Dwarf nandina	*Nandina* spp.	Sun/shade	Reddish evergreen foliage. 
Dwarf pittosporum	*Pittosporum tobira wheeleri*	Sun/shade	 Small, round evergreen.
Dwarf Chinese holly	*Ilex cornuta rotunda*	Sun/shade	Glossy evergreen foliage. 
Abelia	*Abelia grandiflora*	Sun	 Mostly suitable for arid regions.
Sage	*Salvia greggi*	Sun	The flowers are borne on racemes and can be red, pink, purple, orange, or white. 
Small shrubs (3-5 ft.)			
China rose	*Rosa chinensis*	Sun	 Hardy; long-blooming; pest-resistant; varieties: Old Blush (pink) and Cramiosi Superior (red).
Tea rose	*Rosa odorata*	Sun	Hardy; long blooming; pest -resistant; excellent varieties: Mrs. B.R. Cant (rose), Mrs. Dudley Cross (yellow) and Duchesse de Brandant (pink).

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Juniper	*Juniperus* sp.	Sun	Tough, evergreen shrub; many varieties available. 
Dwarf palmetto	*Sabal minor*	Sun/shade	Trunkless, bushy palm. 
Gardenia	*Gardenia jasminoids*	Sun	Produce white fragrant flowers throughout the summer. 
Common lantana	*Lantana camera*	Sun	Small tubular shaped flowers having four petals and arranged in clusters at the end of stems and colours including red, yellow, white, pink , blue and orange which differ depending on location, age and maturity. 
Medium Shrubs (6-9 ft. tall)			
Althea	*Hibiscus syriacas*	Sun	 Upright; deciduous; many colors; summer blooming.
Central Texas sage	*Leucophyllum* sp.	Sun	Dusty grey evergreen foliage; blooms throughout summer.

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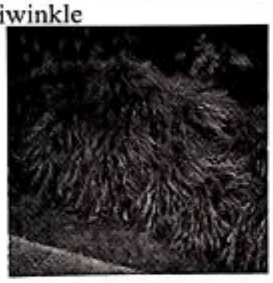
Chinese horned holly	*Ilex cornuta*	Sun/shade		Glossy evergreen foliage.
Italian jasmine	*Jasminum humile*	Sun	Sprawling evergreen; yellow summer Flowers.	
Forsythia	*Forsythia intermedia spectabilis*	Sun/shade	Yellow spring flowers. 	
Pomegranate	*Punica granatum*	Sun	Large, upright shrub; orange blooms; edible fruit; dwarf variety: Chico.	
Winter honeysuckle	*Lonicera fragrantissima*	Sun/shade		Fragrant clusters of white flowers in winter.
Chinese privet	*Ligustrum sinense* variegatum	Sun	Deciduous shrub, flowers are white, with a four lobed corolla 3.5	
Variegated pittosporum	*Pittosporum tobira variegata*	Sun/shade		Green/white variegated evergreen shrub

Crape myrtle	*Lagerstroemia indica*	Sun	Shrubby to tree -like; summer blooming; many flower colors available.	
Oleander	*Nerium oleander*	Sun		Evergreen foliage; summer blooming; many colors available.
Vitex	*Vitex agnus-castus*	Sun	Tree-like; flowers blue or white; summer blooming.	
Lilac	*Syringa vulgaris*	Sun		Deciduous blooming shrub; adapted to alkaline soil.
Mock orange	*Philadelphus coronarius*	Sun	Fragrant white blooms in late spring.	
Russian olive	*Eleagnus angustifolia*	Sun/shade		Gray foliage; yellow flowers; evergreen for windbreak plantings.
Windmill palm	*Trachycarpus fortunei*	Sun	Tree-like; fibrous bark.	
Spanish dagger	*Yucca gloriosa*	Sun		Inflorescence is a panicle up to 2.5 m (8 ft) long, of bell-shaped white flowers.

Bougainvillea	*Bougainvillea glabra or Bougainvillea brasiliensis*	Sun	 It can be grown as a hedge, groomed as a ground cover, pruned as an espalier, trained as a tree or contained in a pot in a variety of shapes. It comes in many colors. i.e. Purple, lavender, carmine, scarlet, red, pink, orange, yellow and white. Single and double flower forms are available. Its bracts appear on the ends of new growth. Habitat -Well drained sandy desert soils, slopes and rocky soil.

Examples of ground covers

Common name	Scientific name	Particulars
Creeping juniper 	*Juniperus horizontalis*	The leaves are arranged in opposite decussate pairs, or occasionally in whorls of three; the adult leaves are scale-like.
Mondo grass 	*Ophiopogon japonicus*	An evergreen, sod-forming perennial plant, leaves are linear, 20–40 cm long, flowers are white through pale lilac, borne in a short raceme.
Periwinkle 	*Vinca minor*	Flowers are solitary in the leaf axils, they're violet purple in colour.
Himalayan sarcococca 	*Sarcococca hookerana humilis*	It produces aromatic white flowers throughout winter followed by black berries.

Examples of Hedges.

Common name	Scientific name	Particulars
Korean boxwood	*Buxus microphylla koreana*	Low growing to 2 1/2 feet high, this shrub does well in a hot, dry climate. It can be sheared to a geometric shape or left untrimmed and still be a tidy plant.
Photinia	*Photinia x fraseri*	Moderate to fast growing shrub to 10 feet high. Has reddish-bronze leaves in Spring and white flower heads that can be as big a small saucer. Sometimes suffers from lack of iron (chlorosis).
Indian Hawthorn	*Raphiolepsis indica*	Best known as a low mounding plant with dark green leaves and pretty pink blooms in the spring. Relatively low water usage.
Myrtle	*Myrtus communis*	Fine textured, bright green foliage that does not need much trimming. It has small white flowers and, later, blue-black berries. Low water usage with good drainage required. Makes a wide hedge.
Indian Fig Cactus	*Opuntia ficus-indica*	Extremely drought toleran t, cold hardy and a fast grower. This plant can reach around 15 feet in height and 10 or more feet in width. Flowers are typically yellow - orange, large and very showy. Fruits green to purplish -red. Cactus thorns are modified leaves.

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