



Research article

A checklist of succulent plants of Ahmedabad, Gujarat, India

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Abstract: The study deals with the diversity of succulent plants in Ahmedabad. Succulent plants are increasingly popular among plant collectors, home gardeners and professional landscapers for colorful leaves, sculptural shapes, simple care, etc. Succulents are widely used for the indoor gardening as well as outdoor gardening for their outstanding appearance. The study reported 73 species of succulent plants from Ahmedabad.

Keywords: Diversity - Succulent - Cactus - Ahmedabad.

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INTRODUCTION

Succulent plants have a global distribution and represented in nearly all habitat type. Over 30 botanical families have succulent plant species, ranging from tiny annuals plants to huge tree (IUCN 1997). Succulence is an adaptive response to drought, rapid drainage in rocky and sandy soil, high evaporation in windy, hot environments and in salty or alkaline habitats. There are probably more than five thousand species worldwide (Newton & Chan 1998).

The "Succulent Karoo" of South Africa and Namibia boasts the richest succulent flora of Earth. Mexico is the country with the highest diversity of cactus in the American continent (Ortega & Héctor 2006). More than 60 species are listed in the Red Data Book of the International Union for the Conservation of Nature (IUCN) (IUCN 2003). Many of these species has an outstanding biological, cultural, and economical importance. Several species of cactus are among the most dominant plants in different vegetation types, where they interact with a large variety of animal and plant species (Héctor *et al.* 2003).

All the succulents evolved from other related plants growing in a normal environment by adaptation to the changing climatic conditions of their habitat, especially the regularity and amount of rainfall. This process of adaptation varied in every family and doubtless many plants succumbed in the struggle for survival. Water is essential for the growth and life of all vegetation, including the succulents, which have mastered the art of economizing water (Rudolf 1980). In geological times, the earth's climate changed becoming drier as the mountains were pushed up to create rain shadows and deserts. Other plant families adapted similarly to these conditions and there are thousands of succulent species (Edwards & Donoghue 2006).

Succulent plants are increasingly popular among plant collectors, home gardeners and professional landscapers for a number of reasons. With their colorful leaves, sculptural shapes and simple care, succulents are beautiful yet forgiving plant for pots (Debra 2010). Succulents are highly diverse. The present study shows diversity in the succulents. They are highly ignored by taxonomist in Gujarat just because many of them are ornamental. Now days succulents are used in outdoor and indoor gardening at various place like malls, industries, colleges, hospitals and gardens in the city of Ahmedabad. So there is urgent need to have documentation of such ornamental groups also.

MATERIALS AND METHODS

Study area

Ahmedabad is located 23.01° N Latitude and 72.61° East Longitude covering 8,086.81 km² area at an altitude of 55 m above the sea level (Qureshimatva *et al.* 2016). Ahmedabad has a hot semi-arid climate, with

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marginally less rain than required for a tropical savanna climate. There are three main seasons: summer, monsoon and winter. Aside from the monsoon season, the climate is extremely dry. The weather is hot through the months of March to June; the average summer maximum is 41°C (106°F), and the average minimum is 27°C (81°F). From November to February, the average maximum temperature is 30°C (86°F), the average minimum is 15°C (59°F), and the climate is extremely dry. Cold northerly winds are responsible for a mild chill in January. The southwest monsoon brings a humid climate from mid-June to mid-September. The average annual rainfall is about 800 millimeters (31 in), but infrequent heavy torrential rains cause local rivers to flood and it is not uncommon for droughts to occur when the monsoon does not extend as far west as usual. The highest temperature recorded is 48.5°C (119.3°F) (Anonymous 2012).

Field work

Field work was carried out during 2013 to 2014. The visits were conducted across various gardens; nursery besides these also visited some people who has a personal collection of cactus and succulent. During field work the photos of each succulent were taken along with habit, stem, leaves and other floral parts. Field notes were taken to have information on habit, habitat and characteristics of succulents. All the specimens were identified with the help of available literature (Anderson 2012, Mary 2000, Qureshimatva 2016, Rudolf 1980, Scott 2012, Shah 1978).

RESULTS AND DISCUSSION

In the present study 45 genera and 73 species with 1 sub sp., 5 varieties and 2 cultivated varieties belonging to 15 families have been reported from the study area (Fig. 1; Table 1). In the present study 5 succulents were reported as indigenous and endemic to India. Other succulents were introduced from the Madagascar, Southern Africa, Brazil, Europe, Mexico, Tropical America, etc. (Fig. 2).

Table 1. List of succulent plants occurring in Ahmedabad.

S.N.	Botanical Name	Family	Common Name	Native	Propagation	Distribution
1	<i>Portulaca oleracea</i> L.	Portulacaceae	Purslane, Lunia	Western Asia	Stem cutting	Common in Ahmedabad
2	<i>Portulaca pilosa</i> L.	Portulacaceae	Kiss me quick	North America	stem cutting	Gurjar vaani, Gujarat University Campus.
3	<i>Commiphora wightii</i> (Arn.) Bhandari	Burseraceae	Gugal	Central Asia	Seeds or stem cutting	Serenity
4	<i>Cissus quadrangularis</i> L.	Vitaceae	Veldt Grape, Devil's Backbone	Southern and eastern Africa, Arabia to India	Stem cutting	Gujarat University Campus
5	<i>Cissus rotundifolia</i> Vahl	Vitaceae	Venezuelan Treebine, Arabian wax cissus	Africa	Stem cutting	K. H. Bhatt's house.
6	<i>Bryophyllum delagoense</i> (Eckl. & Zeyh.) Druce	Crassulaceae	Mother of Millions	Madagascar	Leaf cutting	Gujarat University Campus
7	<i>Bryophyllum fedtschenkoi</i> (Raym.-Hamet & H.Perrier) Lauz.-March.	Crassulaceae	Air plant, Cathedral bells	Madagascar and Southern Africa	Leaf cutting	Common in Ahmedabad
8	<i>Kalanchoe blossfeldiana</i> Poelln	Crassulaceae	Flaming Katy, Christmas Kalanchoe, Florist Kalanchoe	Madagascar	Stem cutting	Common in Ahmedabad

9	<i>Kalanchoe tetraphylla</i> H. Perrier	Crassulaceae	Desert's Cabbage Paddle plant	South Africa	Stem cutting	Gujarat University Campus
10	<i>Kalanchoe tomentosa</i> Baker	Crassulaceae	Panda plant, Plush plant, Pussy ears. chocolate soldier	Madagascar	Leaf cutting	Common in Ahmedabad
11	<i>Sedum album</i> L.	Crassulaceae	Coral Carpet, White stonecrop	Europe	Stem cutting	Gujarat University Campus
12	<i>Sedum morganianum</i> E.Walther	Crassulaceae	Burro's tail or donkey tail	South Africa	Stem cutting	Some private and Home gardens
13	<i>Acanthocereus tetragonus</i> (L.) Hummelinck	Cactaceae	Triangle cactus	South Texas to Venezuela, on the Atlantic coast of Central America	Seeds or grafting	Gujarat University Campus
14	<i>Astrophytum myriostigma</i> Lem	Cactaceae	Bishop's Cap, Bishop's Hat	Highlands of central and northern Mexico	Seeds or Grafting	K. H. Bhatt's house.
15	<i>Brasiliopuntia brasiliensis</i> (Willd.) A.Berger	Cactaceae	Brazilian Prickly Pear	Brazil	Seeds and stem cuttings	Gujarat University Campus
16	<i>Cereus hexagonus</i> (L.) Mill	Cactaceae	Hedge cactus, spiny tree cactus	South America	Stem cutting	K. H. Bhatt's house.
17	<i>Echinocactus grusonii</i> Hildm.	Cactaceae	Golden Barrel Cactus	Mexico	Seeds	K. H. Bhatt's house.
18	<i>Echinocactus texensis</i> Hopffe	Cactaceae	Horse Crippler, Devil's head	Mexico	Seeds	Gujarat University Campus
19	<i>Epiphyllum anguliger</i> (Lem.) G.Don	Cactaceae	Rickrack Cactus	Mexico	Leaf cutting	The Sarabhai Foundation Botanical Garden
20	<i>Epiphyllum oxypetalum</i> (DC.) Haw.	Cactaceae	Brahmakamal	Mexico	Rhizome, herbaceous stem and leaf cutting or layering	Private gardens
21	<i>Ferocactus peninsulae</i> (A.A.Weber) Britton & Rose	Cactaceae	Barral cactus	Mexico	Seeds	Gurjar vaani
22	<i>Hamatocactus</i> sp.	Cactaceae	Turk's head	Native of Argentina and Paraguay	Seed or cutting	Dept. of Botany Gujarat University
23	<i>Harrisia martinii</i> (Labour.) Britton	Cactaceae	Harrisia cactus, Moonlight cactus	Argentina and Paraguay	Stem cutting	Gujarat University Campus

24	<i>Mammillaria beneckeii</i> Ehrenb	Cactaceae	Mammillaria	Mexico	Seeds	Gujarat University Campus
25	<i>Myrtillocactus geometrizans</i> (Mart. ex Pfeiff.) Console	Cactaceae	Blue Candle	Northern central Mexico down to Oaxaca	Seeds, cuttings in summer	Gujarat University Campus
26	<i>Opuntia cochenillifera</i> (L.) Miller	Cactaceae	Cochineal nopal cactus, warm hand	Mexico	Seeds or stem cutting	Serenity Library, Bhat
27	<i>Opuntia cylindrica</i> (Lam.) DC	Cactaceae	Cane cactus	Ecuador and Per	Stem cutting	Private garden near Sardar Stadium, Gujarat University Campus
28	<i>Opuntia elatior</i> Mill	Cactaceae	Prickly Pear, Slipper Thorn, Phafdo Thor	Central America	Seeds or stem cutting	Gujarat University Campus
29	<i>Opuntia microdasys</i> (Lehm.) Pfeiff	Cactaceae	Branching Beavertail	Mexico	Stem cutting or Seeds	Serenity, Gujarat University Campus
30	<i>Pereskia grandifolia</i> Haw	Cactaceae	Rose cactus	Brazil (Uncertain)	Cutting or seed	Serenity
31	<i>Schlumbergera kautskyi</i> (Horobin & McMillan) N.P.Taylor	Cactaceae	Christmas Cactus	Brazil (Espírito Santo, Minas Gerais)	Stem cutting	Private gardens
32	<i>Aptenia cordifolia</i> (L.f.) Schwantes	Cactaceae	Baby Sun Rose	North America	Stem cutting	Private gardens
33	<i>Adenium obesum</i> Roem. & Schult	Apocynaceae	Desert rose	Africa	Seeds, grafting and cutting	K. H. Bhatt's house.
34	<i>Pachypodium lamerei</i> Drake	Apocynaceae	Madagascar Palm, Club Foot	Madagascar	Seeds	Science city garden and K. H. Bhatt's house.
35	<i>Plumeria alba</i> L.	Apocynaceae	White champa	South America	Seed	Gujarat University Campus
36	<i>Plumeria rubra</i> L.	Apocynaceae	Champa	America	Seeds	Gujarat University Campus
37	<i>Ceropegia bulbosa</i> Roxb. var. <i>lushii</i> (Grah.) Hook.f.	Asclepiadaceae	Bulbous Ceropegia	Africa	Nodal segments	Gujarat University Campus
38	<i>Sarcostemma acidum</i> Voigt	Asclepiadaceae	Soma	India and Africa	Seed	Serenity Library, Bhat.
39	<i>Bacopa monnieri</i> (L.) Wettst	Scrophulariaceae	Brahmi, Baam	India	Stem cutting	Gujarat University Campus
40	<i>Basella alba</i> L.	Basellaceae	Red vine spinach	Asia	Seed	Gujarat University Campus
41	<i>Alluaudia procera</i> (Drake) Drake	Didiereaceae	Madagascan Ocotillo	Southern & south-western Madagascar (Toliara)	Stem cutting	Gujarat University Campus

42	<i>Aemarlmeidia fusiformis</i> (Buch.-Ham) S.M. Almeida & S. Dutta ex Santosh Yadav & Rashmi Sharma	Euphorbiaceae	Thor	-	Stem cutting	Gujarat University Campus
43	<i>Euphorbia antiquorum</i> L.	Euphorbiaceae	Thor	Peninsular India	Seed	Common in Ahmedabad
44	<i>Euphorbia cristata</i> B.Heyne ex Roth	Euphorbiaceae	Thor, Neurang	-	Stem cutting	Science city
45	<i>Euphorbia milii</i> Des Moul.	Euphorbiaceae	Thor	-	Stem cutting	Gujarat University Campus, St. Xavier College Campus
46	<i>Euphorbia milii</i> var. <i>splendens</i> (Bojer ex Hook.) Ursch & Leandri	Euphorbiaceae	Crown of thorns		Stem cutting	Gujarat University Campus, St. Xavier College Campus.
47	<i>Euphorbia neriifolia</i> L.	Euphorbiaceae	Thor, Neurang	India	Stem cutting	Common in Ahmedabad
48	<i>Jatropha podagrica</i> Hooker	Euphorbiaceae	Buddha belly plant, Bottle plant shrub	Tropical America	Seeds	Common in Ahmedabad
49	<i>Pedilanthus tithymaloides</i> (Linn.) Poit	Euphorbiaceae	Nivali, Vilayati-she	Tropical America	Stem cutting	Common in Ahmedabad
50	<i>Pedilanthus tithymaloides</i> subsp. <i>smallii</i> (Millsp.) Dressler	Euphorbiaceae	Nivali, Vilayati-she	-	Stem cutting	Common in Ahmedabad
51	<i>Pedilanthus tithymaloides</i> var. <i>variegatus</i> (L.) Poit	Euphorbiaceae	Nivali, Vilayati-she	-	Stem cutting	Law garden
52	<i>Synadenium grantii</i> Hook.f.	Euphorbiaceae	African Milk Bush	East Central Africa.	Stem cutting	Private garden
53	<i>Tirucalia indica</i> Raf.	Euphorbiaceae	Sher, Indian Tree Spurge, saptala (in Sanskrit)	South Africa	Stem cutting	Private garden near SG highway
54	<i>Aechmea distichantha</i> Lem	Bromeliaceae	Brazilian vaseplant	Brazil	Offsets	Private garden
55	<i>Aechmea fasciata</i> (Lindl.) Baker	Bromeliaceae	Silver vase plant	Brazil	Offsets	Gujarat University Campus
56	<i>Deuterocohnia scapigera</i> (Rauh & L.Hrom.) M.A.Spencer & L.B.Sm.	Bromeliaceae	-	-	Seed	Private garden
57	<i>Agave americana</i> L.	Agavaceae	Century plant, American aloe	Mexico	Suckers	Common in Ahmedabad
58	<i>Agave sisalana</i> Perrine ex Engelm	Agavaceae	Baby Sun Rose,	Mexico	Suckers	Common in Ahmedabad
59	<i>Agave victoriae-reginae</i> T.Moore	Agavaceae	Baby Sun Rose	Mexico	Seeds or Suckers	Common in Ahmedabad
60	<i>Agave vivipara</i> L.	Agavaceae	Caribbean Century Plant	-	Suckers	Serenity

61	<i>Nolina recurvata</i> (Lem.) Hemsl	Agavaceae	Pony Tail Palm	Tamaulipas (Mexico)	Seeds	K. H. Bhatt's house.
62	<i>Yucca loifolia</i> L.	Agavaceae	Spanish bayonet	-	Seeds	Gujarat University Campus
63	<i>Sansevieria cylindrica</i> Bojer ex Hook	Sansevieriaceae	Sansevieria	Native to Tropical Asia and natal	Leaf cutting	Gujarat University Campus
64	<i>Sansevieria ehrenbergii</i> Schweinf. ex Baker	Sansevieriaceae	Blue sansevieria, sword sansevieria	Africa	Leaf cutting	Serenity
65	<i>Sanseneria hyacinthoides</i> (L.) Hort ex Staud	Sansevieriaceae	Piles root	Africa	Leaf cutting	Gujarat University Campus
66	<i>Sansevieria kirkii</i> Baker	Sansevieriaceae	Snake plant	Kenya (Africa)	Leaf cutting	Serenity
67	<i>Sansevieria trifasciata</i> Prain	Sansevieriaceae	Mother-in-law's tongue	Africa	Leaf cutting	Gujarat University Campus
68	<i>Sansevieria trifasciata</i> cv <i>golden hahnii</i>	Sansevieriaceae	Mother-in-law's tongue	Africa	Leaf cutting	Private gardens
69	<i>Sansevieria trifasciata</i> cv <i>hahnii</i> Graff	Sansevieriaceae	Mother-in-law's tongue	Africa	Leaf cutting	Private gardens
70	<i>Sansevieria trifasciata</i> var. <i>laurentii</i> (De Wild.) N.E.Br	Sansevieriaceae	Mother-in-law's tongue	Belgian Congo	Leaf cutting	Gujarat University Campus
71	<i>Aloe deltoideodonta</i> Baker	Aloeaceae	Baby Sun Rose	Madagascar	Offshoots	Private gardens
72	<i>Aloe maculata</i> All	Aloeaceae	Baby Sun Rose	South Africa	Rhizome, tubers, corns or bulbs	Private gardens
73	<i>Aloe vera</i> (L.) Burm. f.	Aloeaceae	Baby Sun Rose	South Africa	Offshoots	Common in Ahmedabad
74	<i>Gasteria batesiana</i> G.D.Rowley	Aloeaceae	-	South Africa	Offshoots	Serenity
75	<i>Gasteria obliqua</i> (Aiton) Duval.	Aloeaceae	-	South Africa, Lesotho and Swaziland.	Offshoots	Serenity
76	<i>Haworthia coarctata</i> var. <i>adelaidensis</i> (Poelln.) M.B.Bayer	Aloeaceae	-	South Africa	Offshoots	K. H. Bhatt's house.
77	<i>Haworthia fasciata</i> (Willd.) Haw	Aloeaceae	Variegated Zebra plant	South Africa	Offsets, leaves	K. H. Bhatt's house.
78	<i>Haworthia glauca</i> Baker	Aloeaceae	-	Eastern Cape of South Africa	Seeds and offsets	Private gardens
79	<i>Haworthia limifolia</i> Marloth	Aloeaceae	File Leafed Haworthia	South Africa	Seeds, Offsets or leaf cutting	Shraddha house and Serenity



Figure 1. Photographs of some succulents: **A**, *Portulaca pilosa* Linn. Spp. Grandiflora(Hook.) Gesink; **B**, *Portulaca pilosa* L.; **C**, *Cissus rotundifolia* Vahl; **D**, *Bryophyllum fedtschenkoi* (Raym.-Hamet & H.Perrier) Lauz.-March; **E**, *Kalanchoe blossfeldiana* Poelln; **F**, *Echinocactus grusonii* Hildm; **G**, *Opuntia microdasys* (Lehm.) Pfeiff.; **H**, *Ferocactus peninsulae* (A.A.Weber) Britton & Rose; **I**, *Plectranthus amboinicus* (Lour.) Spreng; **J**, *Aechmea fasciata* (Lindl.) Baker.; **K**, *Agave victoriae-reginae* T.Moore Gard.; **L**, *Aloe maculata* All.

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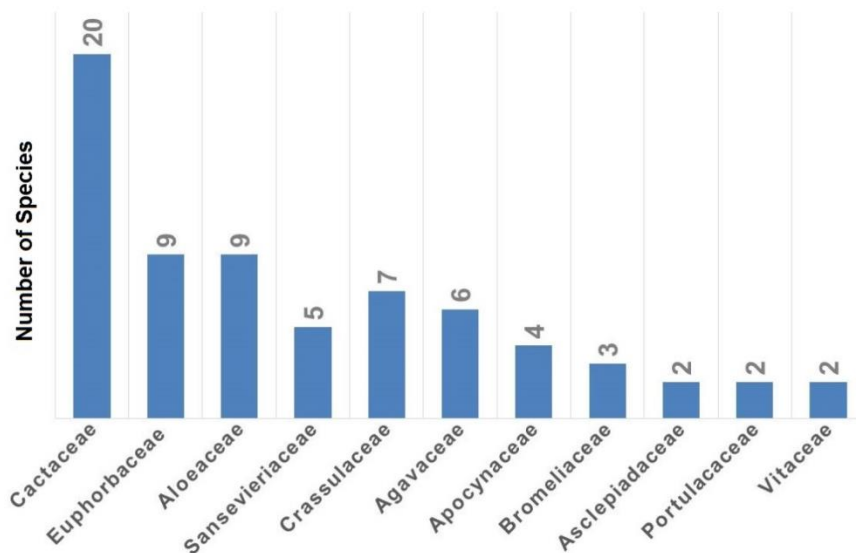


Figure 2. Number of succulent species in dominant families.

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