

CRASSULACEAE STONECROP FAMILY

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Succulent annual or perennial plants, ours herbaceous and papillose or mostly glabrous. LEAVES opposite or alternate, without stipules, in ours sessile, simple, mostly entire, sometimes in dense rosettes. INFLORESCENCES mostly cymes, the branches commonly one-sided, zigzag, at first coiled; or flowers solitary. FLOWERS actinomorphic or nearly so, 3-many-merous, commonly 5-merous, in ours perfect; sepals in ours separate or nearly so; petals as many as sepals, separate or united; stamens as many as sepals or twice as many, free or on corolla base; pistils as many as sepals, mostly separate or nearly so, each with nectar gland at base. FRUIT of follicles, each with one to many tiny seeds. --Ca. 40 genera and 1500 spp., mostly of n temperate regions and s Afr. Many ornamentals and a few minor medicinal plants.

1. Tiny annuals with opposite leaves; stamens as many as sepals; flowers 3- or mostly 4-merous *Crassula*
- 1' Perennials with alternate leaves, the lower sometimes in dense rosettes; stamens twice as many as sepals; flower 5(-8)-merous.
 2. Petals widespreading from near base, separate, not cross-banded with red; flowering stems terminal, with bases surviving and sending up next year's shoots; leaves all much alike, or smaller and gradually different upward, narrowly attached, each by a single strand *Sedum*
 - 2' Petals erect, or if spreading from middle then united 2-3 mm at base and cross-banded above with red; flowering stems lateral, strictly annual from a slower growing, thicker perennial stem; leaves of two kinds, different on perennial stems and annual floral stems, at least those of perennial stems subclasping with several strands at base.
 3. Petals separate, nearly erect; perennial stem bearing brown scale-like leaves only, the foliage leaves scattered on annual floral stems; inflorescence spikelike, dense; growing above 2800 m (9000 ft) *Rhodiola*
 - 3' Petals united 2-6 mm at base, erect or spreading from middle; perennial stem bearing dense rosette of succulent foliage leaves, the leaves of floral stems much smaller; inflorescence broad, open, of two to several one-sided cymes; growing below 2150 m (7000 ft).
 4. Flowers tubular, the petals erect or with the very tips out-curved, uniformly red or yellow; stamens erect, included *Dudleya*
 - 4' Flowers open, the petals spreading from near middle, cross-banded above with red; stamens reflexed in age *Graptopetalum*

Crassula L.

Succulent shrubs or mostly herbs; our tiny annuals. LEAVES opposite, entire in ours, connate at base, with glands (hydathodes) in our in submarginal row. INFLORESCENCE mostly cymose or thyroid, in ours the flowers solitary in axils of leaves, either 1 or 2 per node, the flowers clustered when upper leaves smaller and crowded. FLOWERS mostly 5-merous, in ours (3-)4-merous; sepals nearly separate; petals in ours separate; stamens as many as and opposite sepals; nectar glands in ours linear; pistils separate. FOLLICLES 1-many-seeded. SEEDS in our red-brown, 0.3-0.6 mm long, striate lengthwise, sometimes also papillate. $x = 7, 8$. --Perhaps 300 spp.; mostly Afr., but annual spp. on all continents. (Latin: *crassus* = thick + diminutive suffix). Bywater, M., and G. E. Wickens. 1984. Kew Bull. 39:699-728. Moran, R. 1992. Cact. Succ. J. (Los Angeles) 64:223-231.

1. Sepals acute to aristate, slightly shorter to longer than petals; follicles 1-2-seeded; flowers mostly 2 per node; common in sandy to rocky soil below 1550 m (5000 ft) *C. connata*
- 1' Sepals subacute to rounded, about half as long as petals; follicles 6-17-seeded; flowers 1 per node; uncommon, in water and mud, above 2150 m (7000 ft).
 2. Seeds papillate; pedicels scarcely or not elongating, mostly 0.5-1 mm long; leaves linear-attenuate, 3-10 mm long, 0.5 mm wide *C. viridis*
 - 2' Seeds not papillate; pedicels elongating in fruit, 2-19 mm long; leaves oblanceolate, acute, 2-5 mm long, 0.5-1.5 mm wide *C. aquatica*

***Crassula aquatica* (L.) Schönland (aquatic).** --Erect to decumbent herb, to 15 cm long. LEAVES elliptic-oblanceolate, acute, 2-6 mm long, 0.5-1.5 mm wide. FLOWERS 1 per node, 1.2-2 mm long, on pedicels in age 2-19 mm; sepals deltoid-ovate to oblong, subacute to rounded, 0.4-1.3 mm long; petals lanceolate, subacute, 1.0-1.9 mm long. FOLLICLES 6-17-seeded, erect before opening, oblong, subtruncate, the suture straight below, abruptly outcurved through 90° in upper one fourth, the tiny style spreading. SEEDS elliptic-oblong, not papillate. [*C. saginoides* (Maxim.) Bywater & Wickens; *Tillaea aquatica* L.]. --Infrequent, ponds and wet meadows; Apache Co.; 2900 m (9500 ft); Aug-Sep; to AK, Can., Mex., n Eurasia. *C. saginoides* is an inland phase with pedicels elongate in fruit.

***Crassula connata* (Ruiz & Pav.) Berger (united), Pygmy Weed.** --Erect herb, simple to bushy branching, 2-6(-10) cm high, in age red. LEAVES ovate to oblong, obtuse to acute or apiculate, 1-3(-6) mm long, 0.5-1.5(-2) mm wide. FLOWERS (1-)2 per node, mostly crowded, 0.5-1.5 mm long, on pedicels 0-6 mm long; sepals triangular-lanceolate, acute to aristate; petals longer to shorter, narrowly triangular, acute to attenuate. FOLLICLES 1-2-seeded, ovoid, tapering to subterminal style. SEEDS ellipsoid, not papillate. [*Tillaea connata* Ruiz & Pav.; *T. erecta* H. & A.]. Locally abundant in sandy and gravelly soil of washes, hillsides, and flats; Gila, Maricopa, Pima, Pinal, Yavapai cos.; 300-1400 m (1000-4600 ft); Jan-May; CA, OR, TX; Mex. to Chile, Argentina. Bywater & Wickens named 5 vars., 4 extending from CA to Peru or Chile and 3 into AZ, not recognized here.

***Crassula viridis* (S. Watson) Fedde (green).** --Decumbent herb, to 7 cm long. LEAVES linear, acute or attenuate, 3-10 mm long, 0.5 mm wide. FLOWERS 1 per node, 1.2-1.7 mm long, on pedicels mostly 0.2-1 mm long; sepals triangular-ovate, obtuse to rounded, 0.3-0.9 mm long; petals lanceolate, acute, 1.0-1.6 mm long. FOLLICLES 6-17-seeded, slightly divergent, obliquely narrow-ovoid, the suture broadly outcurved through 90° or more from near middle, the tiny style spreading. SEEDS oblong, papillate. [*Tillaea viridis* S. Watson]. --Infrequent, ponds in mts.: Apache, Coconino cos.; 2100-2450 m (7000-8100 ft); Aug-Sep. ID; Mex., Brazil. Possibly not distinct from *C. drummondii* (Torr. & A. Gray) Fedde, of TX, S. Amer., with leaves described as 1.5-3 mm long, obtuse.

Dudleya Britton & Rose

Glabrous perennials. LEAVES alternate, subclasping, entire, in dense basal rosettes. FLORAL STEMS lateral, overtopping rosettes, annual, with scattered smaller leaves; cymes of 2-several one-sided branches. FLOWERS 5-merous, in ours odorless; sepals equal, nearly separate, erect; petals convolute in bud, united below, in ours erect to form tube; stamens 10, on corolla base, included; pistils not narrowed at base, in ours erect. FOLLICLES many-seeded. SEEDS narrowly ovoid, brown, striate, to 1 mm long. $x = 17$. --Ca. 50 spp., sw OR and s NV to s Baja C. and nw Son., Mex. (for W. R. Dudley).

1. Corolla mostly dark red, 9-15 mm long, the lobes nearly equaling tube; rosette leaves oblong-obovate to oblong-oblanceolate, widest near middle, broadly acute to acuminate *D. arizonica*
- 1' Corolla bright yellow, 12-20 mm long, the lobes about four times as long as tube; rosette leaves oblong-lanceolate, widest at base, tapering to narrowly acute apex *D. saxosa*

Dudleya arizonica Rose (of Arizona). --ROSETTES solitary, sessile, 0.5-2(-6) dm wide, of 10-40 leaves, on stems 1-4 cm thick. LEAVES glaucous to chalky, sometimes red in age, oblong to oblong-obovate, broadly acute to mostly long-acuminate, 3-17(-30) cm long, 1-5(-10) cm wide, 2-4(-9) mm thick, the base 1-3.5(-6) cm wide. FLORAL STEMS 1.5-6 dm tall, 2-6 mm thick, red, the 5-20 leaves spreading, cordate-ovate, acute to acuminate, the lowest 1-3.5 cm long, 0.5-2.5 cm wide. CYMES of 3-6 usually ascending branches 4-27 cm long and 4-20-flowered; pedicels mostly erect or ascending, 0.5-1.5 cm long, often bending sharply upward in fruit. FLOWERS: sepals 3-6 mm long; corolla apricot-yellow to mostly deep red, 9-15 mm long, the tube 4-8 mm long. $2n = 34$. [*Echeveria arizonica* (Rose) Kearney & Peebles; *E. pulverulenta* Nutt. subsp. *arizonica* (Rose) Clokey]. --Dry rocky slopes and cliffs of desert mts.; Maricopa, Mohave, Pima, Pinal, Yuma cos.; 150-800 m (500-2700 ft); mostly Apr-Jun; s NV, sw UT, se CA; Baja C. Norte, nw Son., Mex.

Dudleya saxosa (M. E. Jones) Britton & Rose (rocky). --ROSETTES solitary or few, 3-12 cm wide, of 10-25 erect or ascending leaves, on short stem 1-3 cm thick. LEAVES at first glaucous, later green, oblong-lanceolate, tapering from base or slightly wider near middle, narrowly acute, 3-20 cm long, 0.5-2.5 cm wide, 1.5-6 mm thick, the base 0.5-2.5 cm wide. FLORAL STEMS 0.5-4 dm tall, 2-6 mm thick, red, the 5-15 leaves ascending, triangular-lanceolate, acute, the lowest 0.5-7 cm long, 3-10 mm wide. CYMES red, of 2-6 ascending branches 1-12 cm long, 2-12-flowered; pedicels erect, 0.5-2 cm long, straight. FLOWERS: sepals 2.5-7 mm long; corolla yellow or red-marked, 9-20 mm long, the tube 1-4 mm long. $2n = 34, 102?, 136, 170$. --3 subsp. in AZ and se CA.

Subsp. *collomiae* (Rose) Moran (for Rose E. Collom). --LEAVES 5-15(-20) cm long, 1-2.5 cm wide, 2-6 mm thick. FLORAL STEMS 1.5-4 dm tall, 3-6 mm thick. CYME branches 3-12 cm long, 4-12-flowered. FLOWERS: sepals 4-7 mm long; corolla 12-16(-20) mm long. $2n = 102?, 136$. [*D. collomae* Rose; *Echeveria collomae* (Rose) Kearney & Peebles; *Cotyledon parishii* and *C. saxosa* sensu Tidestr. & Kittell]. --Rock crevices and rocky slopes; Gila, Maricopa, Mohave, Pinal, Yavapai cos.; 450-1800 m (1500-6000 ft); Mar-Jun.

Graptopetalum Rose

Glabrous or papillose perennials. LEAVES alternate, entire, in ours subclasping, in dense basal rosettes. FLORAL STEMS lateral, overtopping rosettes, annual, with scattered smaller leaves; cymes flat or paniculate, of 2-several one-sided branches. FLOWERS 5-8-merous, musky; sepals subequal, nearly separate, erect; petals imbricate in bud, united below, widespreading or slightly reflexed from near middle, pale yellow irregularly dotted and cross-banded with dark red; stamens twice as many as sepals in ours, on corolla base, reflexed after shedding of pollen; pistils erect, narrowed at base. FOLLICLES many seeded. SEEDS narrowly ovoid, reddish-brown, striate. $x = 30-35$. --13 spp. AZ to Oax., Mex. (Greek *Graptos* = marked with writing + *petalon* = petal).

1. Rosettes solitary or few, 7-16 cm wide, the leaves not apiculate, smooth or nearly so; flowers in fall and winter, 2-3 cm wide, 5-merous, in panicles; se AZ *G. bartramii*
- 1' Rosettes cespitose, mostly 2-6 cm wide, the leaves apiculate, with peg-like papillae; flowers in late spring, 1.5-2 cm wide, mostly 6-7-merous, mostly in flat cymes; c and s AZ *G. rusbyi*

Graptopetalum bartramii Rose (for E. B. Bartram). --ROSETTES solitary or few, 7-16 cm wide, of 15-70 leaves, on stem 1-3 cm thick. LEAVES cuneate-oblong to -obovate, acuminate, 3-9 cm long, 1-4 cm wide, 2-4 mm thick, somewhat glaucous, smooth. FLORAL STEMS 1-3 dm tall, with 5-15 leaves; branches 7-18, to 8 cm long, 1-6-flowered; pedicels 4-18 mm long. FLOWERS 5-merous; sepals triangular-lanceolate, 2-6 mm long, 1.5-2.5 mm wide; corolla 19-28 mm wide, the tube 3-3.5 mm long; pistils abruptly narrowed to styles 0.5-1 mm long; $2n = 62$. [*Echeveria bartramii* (Rose) Kearney & Peebles]. --Infrequent, rock crevices and gravelly slopes in mts.; Cochise, Pima, Santa Cruz cos.; 1200-2050 m (3900-6700 ft); Aug-Feb; Chih., Son?., Mex.

Graptopetalum rusbyi (Greene) Rose (for H. H. Rusby). --ROSETTES densely cespitose, 2-6(-10) cm wide, of 10-35(-50) leaves, on stems 3-10 mm thick. LEAVES rhombic-obovate to oblanceolate, acute to acuminate, slender-apiculate, 1.5-5 cm long, 8-18 mm wide, 1-5 mm thick, not glaucous, with peg-like or subclavate papillae ca. as long as thick. FLORAL STEMS 4-18 cm tall, with 5-22 leaves; branches mostly 2-5, spreading, 1-9 cm long, 1-12-flowered; pedicels mostly 3-8 mm long. FLOWERS (5-)6-7(-8)-merous; sepals elliptic, 2.5-6 mm long, to 1.8 mm wide; corolla 14-21 mm wide, the tube in ours 2-3.5 mm long; pistils gradually narrowed to styles 1-1.5 mm long. $x = 31$ ($2n = 62, 63, 64, 66, \text{ca. } 93, 124$). [*Cotyledon rusbyi* E. Greene; *Dudleya rusbyi* (E. Greene) Britton & Rose; *Echeveria rusbyi* (E. Greene) Nelson & Macbride; *Graptopetalum orpetii* E. Walther]. --Locally common in scattered places, commonly in rock crevices especially on north slopes and on shaded cliffs (at least at lower elevations): Cochise, Gila, Graham, Greenlee, Maricopa, Pima, Pinal, Yavapai cos.; 600-1650 m (2000-5400 ft); Apr-Jun; Chih., nw Sin., Son., Mex.

Rhodiola L. Roseroot

Perennial herbs, ours glabrous, with rootstocks bearing axillary annual floral stems. LEAVES alternate, subclasping, often toothed, broad and rather thin, those of rootstocks scale-like in ours. FLORAL STEMS lateral, overtopping rootstocks, bearing the foliage leaves; inflorescence cymose or in ours spikelike or subcapitate. FLOWERS perfect or imperfect, 4-6-merous, in ours perfect, mostly 5-6-merous; petals separate, in ours nearly erect; stamens twice as many as sepals; pistils erect, separate. FOLLICLES erect, many-seeded. --Ca. 40 spp. in N Hemisphere, mostly montane and subarctic, mostly c Asia (Greek *rhodon* = rose, from odor of rootstock in type species).

Rhodiola rhodantha (A. Gray) Jacobsen (rose flower). Red Orpine. --ROOTSTOCK from stout taproot, to 1 dm high, 0.5-2 cm thick, often closely branching to form clumps, with close-set sessile brown ovate scale-leaves 4-10 mm long and often with persistent stem bases. FLORAL STEMS often several, simple, erect, 1-6 dm tall, 2-6 mm thick, the leaves many, much longer than internodes, linear-oblong to oblanceolate, mostly acute, entire or few-toothed above, 1-3 cm long, 2-7 mm wide, with impressed midveins. INFLORESCENCE 1-7 cm high, 1-3.5 cm thick, the flowers mostly sessile; sepals linear-lanceolate, purplish tipped, 3-9 mm long; petals linear-lanceolate to linear-oblanceolate, acute to acuminate, greenish or white to rose, 6-13 mm long; stamens 4-9 mm long, those opposite petals adnate 1-3 mm; pistils reddish, slender, 5-13 mm high, with slender styles. SEEDS oblong, short-tailed, pale brown, faintly ribbed lengthwise, 2 mm long. $2n = 14$. [*Clementsia rhodanthum* (A. Gray) Rose; *Sedum rhodantha* A. Gray]. Wet meadows, streambanks, rockfields, rock crevices: Apache, Coconino cos.; 2800-3700 m (9000-12,300 ft); Jun-Sep. CO, MT, NM, UT, WY.

Sedum L. Stonecrop

Annuals to shrubs; ours small glabrous to papillose perennial herbs. STEMS in ours dying to base after flowering, the next year's shoots at first making rosettes at base. LEAVES in ours alternate, narrowly attached, linear to obovate, entire. INFLORESCENCE in ours a terminal cyme of several one-sided branches. FLOWERS perfect, in ours sessile, 5-merous, open; sepals equal or unequal; petals in ours white or yellow, separate, spreading from near base; stamens usually, as in ours, twice as many as sepals. FOLLICLES erect or spreading, usually, as in ours, many-seeded. --Ca. 500 spp. mostly in rocky places, widespread mostly in temperate N Hemisphere. (Latin: *sedere* = to sit - the usual derivation; but Berger gave *sedare* = to calm or mitigate, because of the healing properties of some). Clausen, R. T. 1975. *Sedum* of North America north of the Mexican Plateau. Ithaca: Cornell Univ. Press; Uhl, C. H. 1985. *Rhodora* 87:381-423.

1. Flowers yellow; sepals slightly united, not spurred, equal, acute; follicles erect; leaves mostly linear or lanceolate, subterete, the basal mostly papillose; n AZ *S. lanceolatum*
- 1' Flowers white or pinkish; sepals separate, spurred or not, often unequal, acute to blunt; e and se AZ.

2. Follicles nearly erect except for tips; lower leaves mostly spatulate to obovate, plane even when fresh, smooth or often some papillose, acute to truncate *S. cockerellii*
- 2' Follicles widely spreading; lower and upper leaves linear or lanceolate, subterete, mostly smooth, blunt *S. stelliforme*

Sedum cockerellii Britton (for T. D. A. Cockerell). --Tufted, with clustered fleshy white roots and with compact basal winter rosettes that grow out to slender erect or ascending flowering stems 0.5-2 dm high. LEAVES of rosettes obovate to spatulate, acute to truncate, often papillose, 1-6 mm long, 1-4 mm wide, the upper leaves gradually narrower, narrowly spatulate to lanceolate or linear-oblong, acute to obtuse, 5-18 mm long, 1-6 mm wide. CYMES 2-6 cm wide, often with several branches. FLOWERS white or pinkish, 15-20 mm wide; sepals unequal, narrowly oblong or linear, acute to obtuse, weakly or not spurred, 4-9 mm long; petals lanceolate, acute, minutely mucronate, 6-9 mm long, 1-3 mm wide; pistils erect, 5-8 mm high. FOLLICLES nearly erect, abruptly narrowing to styles. SEEDS oblong-elliptic to pyriform, brown, reticulate, 0.6-0.8 mm long. $2n$ in AZ = 28, 32, 58; elsewhere 30, 60, 64. [*S. griffithsii* Rose; *S. wootonii* Britton; *S. wootonii* var. *griffithsii* (Rose) Kearney & Peebles]. --Usually on rocks in partial shade in mts., often among mosses: Apache, Cochise, Coconino, Gila, Graham, Greenlee, Navajo, Pima, Pinal, Santa Cruz, Yavapai cos.; 1050-3500 m (3500-11,500 ft); Jun-Oct. CO, NM, TX; Chih., Son., Mex.

Sedum lanceolatum Torr. (lance-shaped). --Tufted, with fibrous roots and with slender branching stems 3-15 cm high in flower but often decumbent at base and with leafy short sterile branches. LEAVES crowded, subterete, linear to lanceolate, subacute, 4-13 mm long, 1.5-3.5 mm wide, the lower often papillose. CYMES often dense, short-branched, often 2-3 cm wide. FLOWERS yellow, 10-18 mm wide; sepals equal, triangular to lanceolate, acute, slightly united and not spurred, 2-5 mm long; petals triangular-lanceolate, acute to acuminate, 6-11 mm long; pistils erect, 4-9 mm high. FOLLICLES erect, slender, 4-6 mm high, narrowing gradually to divergent styles. SEEDS pyriform, short-tailed, finely ribbed, brown, 1-1.3 mm long. $2n = 16, 32, 48$. --3 or probably 2 subspp. in w N. Amer.

Subsp. *lanceolatum*. LEAVES 4-9 mm long, 1.7-2.5 mm wide. FLOWERS: sepals 2-4 mm long; petals mostly 6-9 mm long, to 3 mm wide. $2n$ in AZ = 32. [*S. stenopetalum* auth. not Pursh]. --Open rocky areas: Apache, Coconino, Navajo cos.; 2000-2400 m (6500-8000 ft); Jun-Aug. CA, NM, n to Yukon and Northwest Territories, Can.

Sedum stelliforme S. Watson (star-shaped). --Stems erect, simple or branching mostly above base, with some sterile branches but few or no basal rosettes, 5-15 cm high in flower, to 5 mm thick, the roots mostly slender. LEAVES often crowded, subterete, linear to oblong, obtuse, truncate to obtuse at base, broadly spurred, mostly smooth at maturity, 4-8(-15) mm long, 1-2 mm wide, often withering persistent. CYMES mostly 2-3-branched, sometimes broad, open, the branches even to 8 cm long. FLOWERS white or at center pinkish, 7-14 mm wide; sepals nearly equal, lanceolate to oblong-lanceolate, blunt, conspicuously spurred, slightly papillose, 2-4(-6) mm long, 1-1.5 mm wide; petals lanceolate, blunt to broadly acute, 4-7 mm long, 1.5-2 mm wide; pistils erect, 4-5 mm high. FOLLICLES widely spreading, the body 3-5 mm long, to 2.5 mm wide, abruptly narrowed into style. SEEDS ovoid, mammillate, 0.5 mm long. $2n = 24$ (White Mts. and NM), 40 (Chiricahua Mts. and s Chih.), other numbers in Mex. [*S. topsentii* Hamet]. --Rocky places in pines: Apache, Cochise, Graham, Greenlee cos.; 1950-3000 m (6400-9800 ft); Jul-Sep. NM; w Chih., Dur., Sin., Mex.

Villadia misera (Lindl.) R. T. Clausen is reported from the San Francisco Mts., AZ (Bull. Torrey Bot. Club 67:196. 1940); but the specimen probably is from Mexico. The report is based on a collection flowering in cultivation (NY, US) supposedly collected by Cannon and Lloyd, 1904. The range otherwise is Zac. to Pue., Mex.