

USGS Weeds in the West project:
Status of Introduced Plants in Southern Arizona Parks

Factsheet for:

***Dimorphotheca sinuata* D.C.**

William L. Halvorson, Principal Investigator
Patricia Guertin, Research Specialist

U.S. Geological Survey / Southwest Biological Science Center
Sonoran Desert Field Station
University of Arizona
125 Biological Sciences East
Tucson, Arizona 85721

Prepared by Patty Guertin
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***Dimorphotheca sinuata* D.C.**

**African daisy, cape marigold, sun marigold, Star of the Veldt,
glandular cape marigold**

family: Asteraceae

synonymous names of the species:

- the first name in each species list is the current and synonymous name used by Kartesz (1994).
- the name in bold type occurring within each species list indicates the plant name used within these documents, which is also the name provided in the southern Arizona NPS exotics database 'soaraz~1.xls' (Holden 1996).

Osteospermum sinuatum (D.C.) Norl.
***Dimorphotheca sinuata* D.C.**

other names found: *Dimorphotheca aurantiaca*

species taxonomy

***Dimorphotheca sinuata* D.C.**, African daisy: From Hickman (1993), Munz (1974), USDA, NRCS, The PLANTS database (2001):

(A glossary is provided at the end of this section for the plant terminology used in this section.)

life strategy: an annual, herbaceous plant. Reproduces from seeds. $2n=18$.

structure: an erect, usually branched, annual herbaceous plant; up to 12 in. (3 dm) tall.

roots: small taproot with fibrous branching roots.

stems: stems 4-12 in. (10-30 cm) long.

branching: stems simple to sparingly branched from base.

stipules: no stipules.

leaves: leaves alternate along stem. Leaves less than 4 in. (10 cm) long, oblong to oblanceolate, entire to coarsely sinuate-dentate; lower leaves tapered to petiole-like base; upper leaves sessile, smaller, sometimes linear. Herbage glandular-pubescent.

inflorescence: composite heads solitary on terminal, long peduncles, 1.2-2.8 in. (3-7 cm) in diameter.

phyllaries: involucre broadly campanulate; phyllaries in one series, linear-lanceolate, 0.4-0.6 in. (10-15 mm) long, acuminate, narrowly scarious-margined.

corolla/petals: receptacle flat or nearly so, naked. Ray flowers fewer than 15, pistillate, corollas yellow to orange, sometimes violet at base or apex, ligules 0.8-1 in. (2-2.5 cm) long. Disc flowers many, perfect, corolla 0.2 in. (4.5-5.5 mm) long, corolla with very short tube and long throat, yellow to orange, often purple tipped. No pappus.

gynoecium: ray flowers with style divided into two long stigmatic branches. Disc flowers with style divided into two short stigmatic branches.

androecium: anthers with ovate or triangular-ovate tips, sagittate at base, short-tailed.

fruit: achenes of ray flowers 3-angled to subterete, 0.2 in. (4-5 mm) long, usually wrinkled or tuberculate. Achenes of disc flowers flattened, 0.1-0.3 in. (6-7 mm) long, obovate, smooth, winged or thickened margins, no pappus.

taxonomic glossary (Harris and Harris 1997):

acuminate: tapering to a sharp point

campanulate: bell-shaped

dentate: toothed along the margin, the teeth directed outward rather than forward (serrate)

lanceolate: much longer than wide; with the widest point below the middle

oblanceolate: inversely lanceolate, with attachment at the narrow end

obovate: inversely ovate, with attachment at narrow end

obtuse: blunt or rounded at the apex

ovate: egg-shaped outline, with attachment at broad end

peduncle: the stalk of a solitary flower or of an inflorescence

perfect: having both male and female reproductive organs

petiole: leaf stalk

pubescent: covered with short, soft hairs

sagittate: arrowhead-shaped with the basal lobes directed downwards

scarious: thin, dry, and membranous in texture, not green

sessile: attached directly, without a stalk

sinuate: having a strongly wavy margin

sub-: meaning under, slightly, somewhat, or almost -

terete: round, in cross section

tubercle: a small tuber-like swelling or projection

tuberculate: having tubercles

image of plant



photo by: © 2000 Joseph M. DiTomaso.
obtained at CalPhotos, Berkeley Digital Library Project:
Dimorphotheca sinuata. Website:
http://elib.cs.berkeley.edu/cgi/calflora_query?one=T&special=photo&where-calrecnum=2733



photo by: © 1973 Dean Wm. Taylor.
obtained at CalPhotos, Berkeley Digital Library Project:
Dimorphotheca sinuata. Website:
http://elib.cs.berkeley.edu/cgi/calflora_query?one=T&special=photo&where-calrecnum=2733



similar native or non-native species that could confuse identification

Although there are many plants in the desert that are early blooming and daisy-like, African daisies/Cape marigolds are one of the earliest bloomers, salmon colored to yellow to orange, and seemingly have no other species that it would be readily misidentified with during its late winter to early spring bloom.

biology

growth and reproductive strategy:

Generally, *Dimorphotheca sinuata* germinates following sufficient rains in the fall and winter and into spring (van Rooyen et al. 1992a, 1992b). Over the winter the plant grows vegetatively, adding biomass. Flower initiation occurs after a drop in temperature during the winter (vernalization) with flowering usually occurring in the spring after temperatures have begun to rise (van Rooyen et al. 1991, Steyn et al. 1996). Typical of annual plant strategies, *Dimorphotheca sinuata* completes its life cycle during favorable environmental conditions and the species survives stressful environmental conditions (i.e. drought and heat) as a seed (van Rooyen et al. 1992b). This species showed a dependence on insect pollination for cross-pollination and successful seed set. Self-compatibility systems were operative, but self-pollination is avoided in this plant by proterandry (maturity of male reproductive system before maturity of female reproductive system) (Ueckermann and van Rooyen 2000). *Dimorphotheca sinuata* produces dimorphic fruits (two different achenes/seeds). These achenes/seeds are morphologically and anatomically different, with each having different responses to environmental conditions, ensuring species' survival in stressful climates (Beneke et al. 1992a, 1992b, 1993a, 1993b, 1993c).

seed production:

no sources found for potential number of seeds/plant. Beneke et al. (1993a) reported that disc achene: ray achene ratios changed for plants growing in different localities under differing conditions.

seed dispersal:

Seeds tend to drop from the plant as soon as they are mature (Knowles et al. 1965). Achenes of the disc flowers are winged, having better dispersal mechanisms than achenes of the ray flowers, which are non-winged (Beneke et al. 1993b).

seed longevity:

Bass (1977) reports on laboratory germination and longevity tests of crop seeds of *Dimorphotheca sinuata*. He found when seeds of various ages were germinated at 59°F (15°C) in germination blotters, germination ranged between 54-73% for seeds less than a year old, 71-84% after 6 years of storage, 71-84% after 11 years, 71-80% after 16 years. Seeds were stored at 41°F (5°C) and at 40% relative humidity. (He reported that reduced germination in the trials of the seeds less than a year old may have occurred because those achenes were not processed to remove non-filled fruit as the achenes of older stock were, or the seeds were potentially dormant). Bass also referred to a past paper, Bass et al. (1967), in which storage conditions were tested. It was found that storage environment had an impact on *Dimorphotheca sinuata* seed longevity. Some horticultural sources report that seeds from this plant have little viability over time.

ecology

origin and history of introduction:

Dimorphotheca sinuata is native to Africa (Angola, Namibia, the Cape Province of South Africa (Namaqualand)) (GRIN 2000, Hickman 1993, Munz 1974).

Dimorphotheca sinuata has been cultivated in Arizona since the 1940's, and has naturalized in various locations since the 1970's (Earle 1973 in Burgess et al. 1991). At the desert laboratory in Tucson the first collection was made in 1978 by Turner and Goldberg; in the 1991 report, *Dimorphotheca sinuata* was reported to be invading edges of the property; it spreads along washes (Burgess et al. 1991). Hickman (1993) states that it is an escape from cultivation, and establishes along roadsides and in disturbed places in California. *Dimorphotheca sinuata* seeds have been identified for quality seed oil; the plant has been investigated for its crop potential (Knowles et al. 1965).

ecological distribution / habitat:

In its native area: *Dimorphotheca sinuata*'s native region is characterized by hot, dry summers, with sparse and erratic rainfall occurring primarily in the winter months (Schulze 1965 in Rösch et al. 1997).

On the North American continent: In the Sonoran Desert, Tucson, Arizona, Burgess et al. (1991) reports that it spreads along washes. In California, it occurs under 3280 ft. elevation, along roadsides and disturbed areas (Hickman 1993).

climatic requirements and limitations:

Dimorphotheca sinuata likes to grow in full sun; its flowers will close in shade. The plants grow over a wide range of temperatures and photoperiods, provided there is sufficient moisture; although it is a drought tolerant plant.

germination requirements:

Dimorphotheca sinuata produces two different types of achenes within each inflorescence; one type from the disc flowers, another from the ray flowers. The germination requirements differ for each type. The disc achenes/seeds are winged, smooth, and larger; the ray achenes/seeds are smaller, not winged, with a wrinkled to tuberculate pericarp which is thicker and tougher. Optimum germination requirements for both disc and ray achenes was found to be between 45-72°F (7-22°C) in light, although the disc achenes/seeds germinated at a rate of 95.5% and the ray achenes/seeds germinated at a rate of 3% (Beneke et al. 1993b). de Villiers et al. (1994) found that the highest germination percentages occurred at 68°F (20°C).

Germination occurs when there is sufficient moisture available in the fall and winter months, although it also can germinate later, in spring. High temperatures reduced germination; this response was suggested as an adaptation to limit germination after rain in the warm, dry season (Beneke et al. 1993b).

The differences between the two types of achenes/seeds are due to anatomical and chemical qualities in the pericarp. The ray achenes/seeds' pericarp not only has extensive sclerenchymous zones and tannins present (mechanical and chemical dormancies), but also a mucilaginous epidermis (Beneke et al. 1992b). Beneke et al. (1993b) reported that the disc achenes/seeds germinated more readily over a wide range of temperatures, in light and dark conditions, and in greater percentages when the conditions were favorable (Beneke et al. 1992b, Beneke et al. 1992a). The mechanical and chemical components of the ray achenes/seeds delay germination during unfavorable conditions (Beneke et al. 1992a, 1992b). Then, when the seeds germinate, the mucilaginous epidermis may contribute to water economy, keeping the achene moist for prolonged periods of time to endure germination (Beneke et al. 1992b). Fruit polymorphism represents a survival strategy; it assures species expansion under favorable conditions and survival under unfavorable conditions (Beneke et al. 1992a, 1992b).

soil preferences:

Dimorphotheca sinuata likes well-drained soils, and will tolerate dry soils (Michigan State University Extension 1999).

competitive abilities:

there is no information concerning this plant's abilities to compete in non-native situations. Many studies were available describing its competitive abilities intraspecifically, or interspecifically within its native environment (see bibliography); none were available for the North American continent.

In Knowles et al. (1965), it was reported that in some of the crop trials on this continent (Georgia, Iowa, Nebraska, North Carolina, Texas, Washington), the plants were plagued by beetles, nematodes, or various fungi, preventing successful growth and/or maturity, but in a number of places (California, Colorado, Kansas, Maryland, Oregon) the crop was more or less successful.

why it has the potential to do well as an exotic:

Dimorphotheca sinuata is native to a relatively similar stressful, arid environment as the Sonoran Desert. It likes desert soils and environments, and is drought tolerant. As an annual forb, its life cycle is synchronized with the climate, actively growing only when favorable conditions are presented, escaping unfavorable conditions (e.g. high temperatures, water stress/drought) as a seed (van Rooyen et al. 1992b). In its native environment, rains are unpredictable, and this ephemeral plant has adapted by acquiring highly flexible (plastic) responses in lifespan, size, biomass allocation (van Rooyen et al. 1992a, 1992b); rapid establishment, growth, and reproduction are advantages in stressful environments.

In addition to these responses, its dimorphism of achenes/seeds lends to an enhanced survivability in variable environments. Further research also showed that the plants that grow from these differing seeds have their own differing capabilities; plants cultivated from the disc achenes/seeds produced more achenes/seeds than those from the ray achenes/seeds. Yet, when under drought conditions, plants from the ray achenes/seeds produced more achenes/seeds (Beneke et al. 1993a). It was also shown that late-sown disc achenes/seeds produced fewer achenes/seeds than if early-sown,

while plants grown from the ray achenes/seeds were not affected by sowing date (Beneke et al. 1993a).

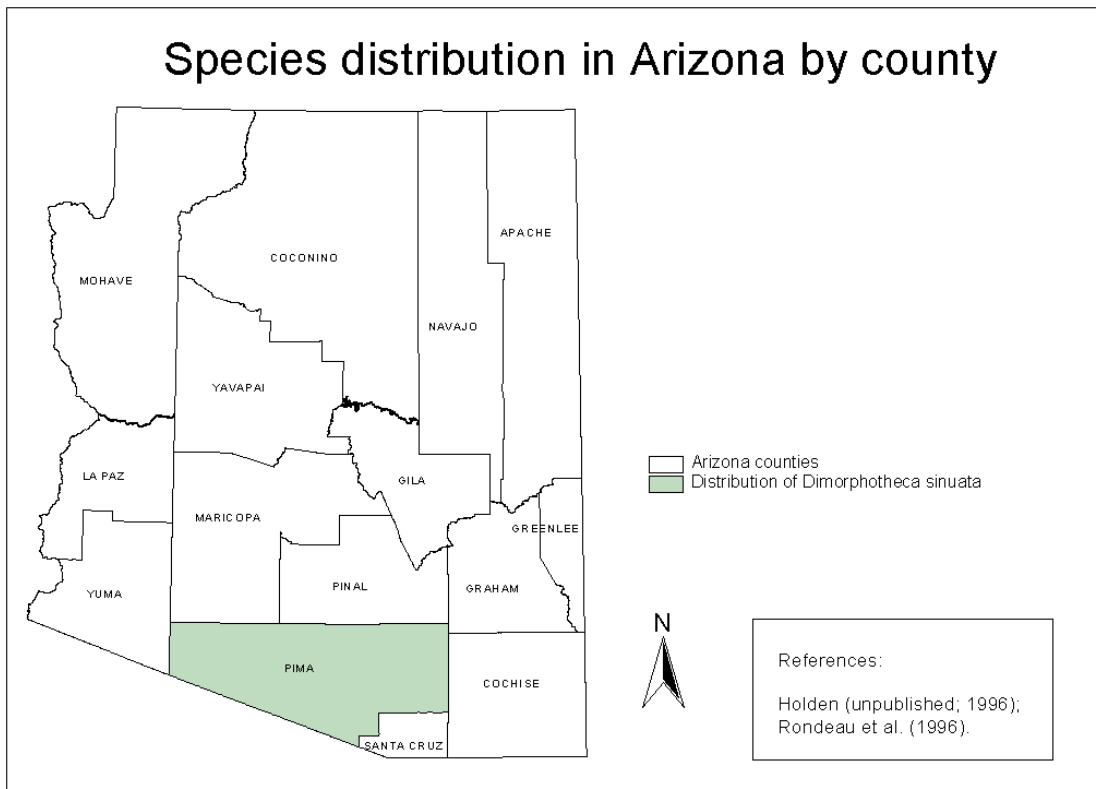
effect on natural processes/description of the threat

no information or sources found: this plant has been encouraged/promoted as an ornamental for low water use situations and for its spectacular displays (as in its native south Africa); until recently, it hasn't been targeted as an invasive non-native species; information is minimal concerning its status as an invasive plant.

known general distribution

United States:

California, Oregon (USDA,NRCS, The PLANTS database 2001: Map available at Website: <http://plants.usda.gov/plants/> ; then enter the common or scientific name), Arizona (Holden 1996, Rondeau et al. 1996).



Arizona, by county:

Rondeau et al. (1996) lists *Dimorphotheca sinuata* (African daisy) in Saguaro National Park, Pima County. Niehaus et al. (1984) states that it occurs in southwest Arizona in the lower deserts.

National Park Service, southern Arizona group:

Casa Grande Ruins National Monument
source listing species' presence in park:

no sources found

Chiricahua National Monument
source listing species' presence in park:

no sources found

Coronado National Memorial
source listing species' presence in park:

no sources found

Fort Bowie National Historic Site
source listing species' presence in park:

no sources found

Montezuma Castle National Monument and Montezuma Well unit
source listing species' presence in park:

no sources found

Organ Pipe Cactus National Monument
source listing species' presence in park:

no sources found

Saguaro National Park
source listing species' presence in park:

Rondeau, R., and R. Van Devender. 1992. Floristic survey of the proposed Wildhorse Canyon Protected Natural Area: Final Report. National Park Service, Funding #1443 PX8670-92-043.

Rondeau, R., T.R. Van Devender, C.D. Bertelsen, P. Jenkins, R.K. Wilson, M.A. Dimmitt. 1996. Annotated flora and vegetation of the Tucson Mountains, Pima County, Arizona. Desert Plants 12(2):3-46.

Tonto National Monument
source listing species' presence in park:

no sources found

Tumacacori National Historical Park
source listing species' presence in park:

no sources found

Tuzigoot National Monument

source listing species' presence in park:

no sources found

Weeds in the West Project

While completing distribution mapping between Spring 1999 through Spring 2001 for the USGS Weeds in the West project in the southern Arizona National Park Service management units, *Dimorphotheca sinuata* (African daisy) was found in the following parks (Guertin 2001):

- Casa Grande Ruins National Monument

- Note: A few plants were observed along a dirt roadside in Saguaro National Park during the spring of 2001 during a non-work related hike in the Tucson Mountain District of the park.

control methods and management strategies

no information or sources found.

contacts or technical specialists

Dr. Francis E. Northam (Ed Northam)

Noxious Weed Coordinator, Plant Services Division

Arizona Department of Agriculture

1688 West Adams Street

Phoenix, Arizona 85007

Phone: (602) 542-3309; FAX: (602) 542-1004 e-mail: ed.northam@agric.state.az.us

Ed works state-wide primarily with noxious agricultural weeds, yet has also done some work to get non-native invasive plants listed that impact Arizona's natural environments

He indicated he would provide, as requested, information regarding:

- weed biology
- control/management of weeds

Dr. John H. Brock

Professor of Applied Biological Science

Coordinator of Sustainable Technologies, Agribusiness and Resources (STAR) Research Center

Arizona State University East

7001 E. Williams Field Rd.

Mesa, Arizona 85212

Phone: (480) 727-1240; FAX (480) 727-1961 e-mail: john.brock@asu.edu

Dr. Brock has done:

- invasive plant work (including control treatments) in essentially all the major vegetation types in Arizona, except the highest elevation types like mixed conifer.

April Fletcher, Arizona Interagency Weed Action Group

U.S. Fish and Wildlife Service
 P. O. Box 1306
 500 Gold Ave.
 Albuquerque, New Mexico 87103
 e-mail: April_Fletcher@fws.gov

April works region-wide with on-the-ground folks. Arizona Interagency Weed Action Group (IWAG) is an ad-hoc group; working on specific projects identified as species of concern by the group. IWAG consists of invasive weed folks from state and Federal resource management agencies.

April is:

- acquainted with control methods for numerous species
- she knows many professionals who are doing control work, so, when she can't supply an answer, she can usually provide contacts who can.

Jim Horsley, Southwest Vegetation Management Association

Arizona Department of Transportation
 2104 S. 22nd Avenue
 Phoenix, Arizona 85009
 Phone: (602) 712-6135 email: jhorsley@dot.state.az.us

Jim indicated at ADOT they manage and control a number of native and non-native invasive species. Their experience includes

- *Centaurea solstitialis* (Yellow) and *Centaurea melitensis* (Malta) star thistle, *Onopordum acanthium* (Scotch), *Carduus nutans* (Musk), and *Cirsium vulgare* (Bull) thistle, *Acroptilon repens* (Russian), *Centaurea biebersteinii* / *Centaurea maculosa* (spotted), and *Centaurea diffusa* (diffuse) knapweed, *Alhagi maurorum* (Camelthorn), *Halogeton glomeratus* (Halogeton), *Salsola* sp. (Russian thistle, tumbleweed), *Linaria damatica* (Dalmation toadflax), *Cardaria draba* (Hoary cress), *Tribulus terrestris* (Puncture vine), *Cenchrus* sp. (sandbur), *Convolvulus arvensis* (Field bindweed), *Sorghum halepense* (Johnsongrass), *Pennisetum ciliare* (Buffelgrass), *Pennisetum setaceum* (Fountain grass), several mustards, *Verbascum* sp. (mullein), *Heterotheca subaxillaris* (Camphorweed) and several others.

Jim has

- personal experience statewide
- and, has access to other experts from several states in the southwest.

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additional sources and websites

Cooperative State Research, Education, and Extension Service

Website: <http://www.reeusda.gov/1700/statepartners/usa.htm>

This website brings you to an interface to connect with Cooperative Extension programs throughout the United States; select the desired state, enter a link, often there is a search option in which information on a plant can be searched for.

USDA, Forest Service, Rocky Mountain Research Station, September 2002 has published 'Linking Wilderness Research and Management. Volume 4 - Understanding and Managing Invasive Plants in Wilderness and Other Natural Areas. An Annotated Reading List. General Technical Report RMRS-GTR-79-volume 4 This volume is available on the Web; Website: http://www.fs.fed.us/rm/pubs/rmrs_gtr079_4.pdf (Website: http://www.fs.fed.us/rm/pubs/rmrs_gtr079_4.html provides some information if problems occur in viewing this file)

websites with great plant photos:

http://ces.asu.edu/collections/vasc_image_library/ImageIndex.jsp then click on appropriate letter, and then scroll down and click on appropriate name