Smooth Desertdandelion

Malacorthix glabrata A. Gray ex D.C. Eaton

Asteraceae – Sunflower Family

Sophia Goss and Ashlee Wolf |2023

ORGANIZATION

NOMENCLATURE

Smooth desertdandelion (*Malacothrix glabrata* A. Gray ex D.C. Eaton) belongs to the Cichoriae tribe of the Asteraceae or sunflower family (Lee et al. 2003, USDA NRCS 2023).

NRCS Plant Code.

MAGL3 (USDA NRCS 2023).

Synonyms.

Malacothrix californica var. *glabrata* A. Gray ex D.C. Eaton (Tropicos 2023).

Common Names.

Smooth desertdandelion, smooth desert-dandelion, desert dandelion, smooth desert dandelion (SEINet 2023).

Subtaxa.

No varieties or subspecies are currently recognized by the Flora of North America (Davis 2020) or the Integrated Taxonomic Information System (ITIS 2023).

Chromosome Number.

The chromosome number for smooth desertdandelion is 2n=14 (CCDB 2023).

DESCRIPTION

Smooth desertdandelion is an annual forb that grows erect from a taproot with flowering stalks that rise to 10-40 cm (Davis 2020). Stems are typically branched, both proximally and distally, with glabrous or sparsely puberulent surfaces near the base (occasionally glaucous) (Davis 2020). The leaves are mostly basal and pinnately lobed with narrow linear, rounded lobes. Plants also have pinnately lobed cauline leaves that become reduced farther up the stem (Davis 2020). Each stem terminates in one to three flowering heads consisting of 31-139 white-yellow (tinged with purple on the undersides) ray flowers held in a bristly receptacle. The involucre is surrounded at the base by twelve to over twenty lanceolate to linear bractlets with translucent margins, ranging between 0.05 and 0.2 mm wide (Davis 2020). Involucre shape ranges from campanulate to hemispheric with twenty to over twenty-five phyllaries in two to three series on the calyx (Davis 2020). The fruits are single-seeded cypsela that are more or less cylindrical in shape, tapered on both ends (cylindro-fusiform), and sometimes weakly five-angled (Davis 2020).

Figure 1: A smooth desertdandelion individual. Photo: BLM CA930A

Figure 2: The basal rosette with linear, pinnately lobed leaves. Photo: Sue Carnahan

Figure 3: The white-yellow ligulate florets of smooth desertdandelion. Photo: Sue Carnahan

Figure 4: The purple-tinged undersides of the ray flowers and the involucre surrounded with bractlets with translucent margins. Photo: Sue Carnahan

DISTRIBUTION AND HABITAT

Smooth desertdandelion primarily occurs in the Mojave, Great Basin and Sonoran Deserts, in California and the intermountain region in Arizona, Nevada, Oregon and Utah (SEINet 2023; Figure 5). Sporadic occurrences extend to adjacent regions in southern Baja California and Colorado Plateau, and in New Mexico and the northwestern range of the Chihuahuan desert.

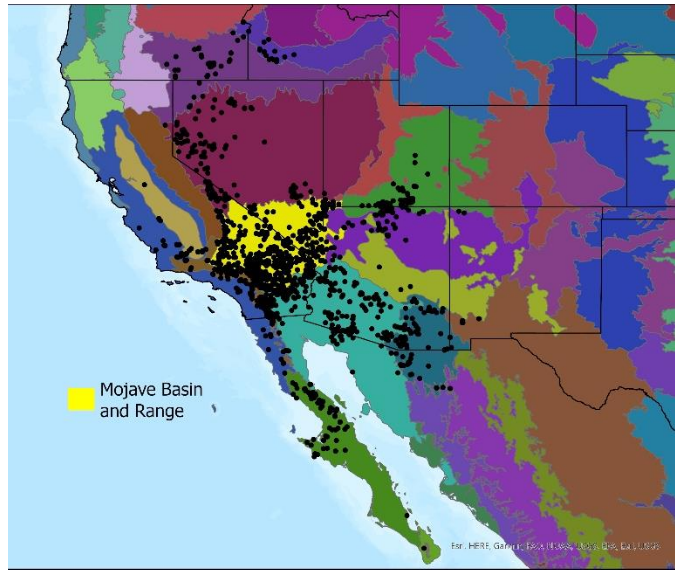

Figure 5: Distribution of smooth desertdandelion based on georeferenced herbarium specimens and verified observations (black circles, SEINet 2022) with EPA Level III Ecoregions (US EPA 2015). The Mojave Basin and Range ecoregion is shown in yellow.

Habitat and Plant Associations.

Smooth desertdandelion grows in coarse soils in open areas or among shrubs in dry desert areas and foothill woodlands (Davis 2012). It is closely associated with creosote (*Larrea tridentata*), but is not confined to shrub canopies and is often found in vegetation gaps (Shmida and Whittaker 1981).

Common associated species in creosote bush scrublands where smooth desertdandelion occurs include fiddlenecks (*Amsinckia* ssp.), sagebrush (*Artemisia* ssp.), and saltbush-creosote (*Atriplex-Larrea*) associations (Davis 2020). Common associated species in the Mojave Desert include creosote bush (*Larrea tridentata*), wait-a-minute bush (*Acacia greggii*), browneyes (*Camissonia claviformis*), chia (*Salvia columbariae*), bristly fiddleneck (*Amsinckia tessellata*), burro-weed (*Ambrosia dumosa*), and distant phacelia (*Phacelia distans*) (BLM SOS 2022).

Figure 6: A robust population of smooth desert dandelion in an open desert habitat in California. Photo: BLM SOS CA930A

Figure 7: Smooth desert dandelion along a sandy wash margin in California. Photo: BLM SOS CA930A

Figure 8: Smooth Desert Dandelion in sandy soils. Photo: Jean Pawek

Climate.

The Mojave Desert is characterized by low annual precipitation (2-10 inches or 5-25 cm in valley areas), with most rainfall occurring in the winter and a smaller amount during summer thunderstorms (Randall et al. 2010).

Heterogenous climate patterns across the region are influenced by large-scale patterns and regional topography and are important drivers of local adaptation and intraspecific variation (Shryock et al. 2018, Baughman et al. 2019) and phenological events (Beatley 1974). Specifically, the reproductive phenology of many desert plant species is highly responsive to pulses in rainfall over short time scales (Bowers and Dimmitt 1994, Zachmann et al. 2021).

Climate information is derived from the climate-based provisional seed transfer zones (PSZs) where smooth desertdandelion occurs (Shryock et al. 2018; Table 1). According to herbarium specimen locations (SEINET 2022), smooth desertdandelion has been documented in all PSZs in the Mojave Desert ecoregion, except Zone 20, the Zone with the highest annual precipitation. It is most abundant in Zones 26 and 21 and least abundant in Zone 20 and 28 (Table 1). The average annual precipitation in the PSZs where smooth desertdandelion occurs in the Mojave Desert ecoregion is 15.7 cm (6.2 inches), with an average of 4.9 cm (1.9 inches) falling in the summer and an average of 10.9 cm (4.3 inches) falling in the winter. Note, herbarium specimen locations may not represent the full distribution and abundance of smooth desertdandelion due to sampling biases and ephemerality of this desert annual.

Table 1: Climate of the provisional seed zones (PSZ) where smooth desertdandelion occurs within the Mojave Desert ecoregion (Shryock et al. 2018). # = the number of herbarium or verified observations of smooth desertdandelion within the PSZ (SEINet 2022); MAP=mean annual precipitation; SP=summer precipitation, or the mean precipitation that falls in the summer (May-October); WP= winter precipitation, or the mean precipitation that falls in the winter (November-April); MAT=monthly average temperature; Range= Average of the monthly temperature ranges (monthly maximum minus monthly minimum).

PSZ	#	MAP (cm)	SP (cm)	WP (cm)	MAT (C)	Range (C)
26	185	14.5	2.7	11.8	16.8	34.9
21	103	15.6	6.2	9.4	18.8	38.4
24	90	10.7	2.8	7.9	18.8	38.6
25	87	16.5	6.2	10.3	18.9	34.6
29	86	25.5	4.2	21.4	13.8	31.7
27	66	9.6	3.3	6.3	20	36.7
23	45	15.8	5.4	10.4	16.1	35.9
20	28	25.5	10.5	14.9	15.3	34.5
28	12	7.8	2.4	5.3	22.3	41.3

Elevation.

Smooth desertdandelion is generally found at elevations below 6500 ft (1981 m) (Davis 2012).

Soils.

Smooth desertdandelion grows in fast draining soils (Calscape 2023), generally with gravel, loam, sand, or silt derived from a variety of parent materials (BLM SOS 2022). Granite is the most frequently recorded parent rock but alluvium derived of mixed sources is also noted in seed collection habitat descriptions (BLM SOS 2022).

No associations with biological soil crusts were noted in the literature.

ECOLOGY AND BIOLOGY

In general, winter annuals are estimated to make up at least 40% of the Mojave Desert flora (Johnson et al. 1978) and fill an important niche by providing pollinator and wildlife forage, ground cover, and potential competition for invasive annual grasses (Brooks 2000, Esque et al. 2021). While smooth desertdandelion typically makes up a small portion of the annual plant community, it is the primary food plant for the solitary bee, *Nomadopsis puellae* (Rutowski and Alcock 1980) and an important food for the threatened desert tortoise (*Gopherus agassizii*) (Jennings and Berry 2015). Smooth desertdandelion was included as an indicator species to objectively define and analyze patterns of "good wildflower years" in the Mojave and Sonoran Deserts (Bowers 2005). NatureServe classifies smooth desertdandelion as globally secure (G5) but it is considered Vulnerable (S3) in Idaho and Apparently Secure (S4) in Oregon and Nevada (NatureServe 2023).

Reproduction.

Breeding System.

Self-compatibility of species in the genus *Malacothrix* varies and the reproductive biology of smooth desertdandelion has not been studied (Davis and Philbrick 1986). However, smooth desertdandelion is insect pollinated (Ruttan et al. 2021) and most likely relies on outcrossing via insect pollination to reproduce. Recent DNA analysis of the genus *Malacothrix* shows it is not a monophyletic lineage and that smooth desertdandelion is located in a clade with other self-incompatible species (Lee et al. 2003).

Reproductive Phenology.

Smooth desertdandelion flowers March to July (SEINet 2023). Flowers close in the early afternoon (Rutowski and Alcock 1980). Fruits mature between March and June (BLM SOS 2022).

Pollination.

Solitary bees in the genera *Anthidium* (Wainwright 1978) and *Nomadopsis* (Rutowski and Alcock 1980) are confirmed pollinators of smooth desertdandelion.

Smooth desertdandelion can have higher frequency and longer duration of pollinator visitation when growing in association with creosote (*Larrea tridentata*) (Ruttan et al. 2021).

Seed and Seedling Ecology.

In general, Mojave winter annuals germinate in response to cool season precipitation (Smith et al. 2013). Like many other desert annuals, the abundance of smooth desertdandelion decreases during drought years (Smith et al. 2013). Smooth desertdandelion is commonly categorized as a beneficiary species of desert shrubs, such as creosote (*Larrea tridentata*), where seeds have higher germination rates in the understory of desert shrubs (Liczner et al. 2017).

The seeds quickly disperse in the wind after ripening (Asbell 2023, personal communication).

No information on seed bank longevity, granivory, seedling hardiness or other aspects of this species' seed and seedling ecology was found in the literature or through personal communications.

Species Interactions.

Belowground Interactions.

Information in the literature about the relationship between smooth desertdandelion and belowground organisms is lacking. A study assessing response of multiple desert species to arbuscular mycorrhizal fungi (AMF)-facilitated restoration in boron contaminated soil found that smooth desertdandelion had lower survivorship when soil was inoculated with AMF (Havener 2013). However, mycorrhizal colonization of plant roots was not assessed in this unpublished study, and a causal relationship cannot be determined.

Insect Interactions.

Smooth desertdandelion is a confirmed host plant for *Heliolonche pictipennis* and a likely host plant for alfalfa looper moth (*Autographa californica*), *Cucullia comstocki*, and *Heliolonche joaquinensis* (Calscape 2023).

Specimens of the ornate checkered beetle (*Trichodes ornatus*) were collected from the flowers of smooth desertdandelion (Barr 1969).

Wildlife and Livestock Use.

The threatened Mojave desert tortoise feeds selectively on desert perennials and annuals, including smooth desertdandelion (Jennings and Berry 2015). Smooth desertdandelion provides juvenile and adult desert tortoises with nutrients, such as calcium, phosphorus and magnesium (Hazard et al. 2010). Smooth desertdandelion has higher digestibility and more available minerals for desert tortoises compared to native and invasive grasses (Hazard et al. 2010).

Other Notable Species Interactions.

Smooth desertdandelion's relationship to desert shrubs is well-studied. Some benefits of growing in the understory of shrubs include protection from predators and wind, and higher pollinator visitation rates (Holzapfel and Mahall 1999, Ruttan et al. 2021). Despite the benefits of growing under shrubs, plant density of individuals in shrub understory compared to open areas does not differ, therefore smooth desertdandelion is considered to have a neutral shrub association (Liczner et al. 2017).

Disturbance Ecology.

There is minimal information on the response of smooth desertdandelion to fire or other disturbance.

Smooth desertdandelion may not compete well with invasive species, indicated by its significantly higher biomass when grown alone than with exotic species in greenhouse experiments (McKinney and Cleland 2014). Smooth desertdandelion has been recorded as a volunteer species in boron contaminated soils suggesting its ability to act as a colonizer species following mining disturbance (Norman Terry Research Group, UC Berkeley, unpublished data, cited in Havener 2013).

Ethnobotany.

The Apache likely used the roots of smooth desertdandelion as blood medicine, though utility for specific blood ailments is not noted (NAEB 2022).

Horticulture.

Smooth desertdandelion is not widely cultivated for horticultural or landscaping use. Some wholesale nurseries carry small quantities of smooth desertdandelion seed (Calscape 2023).

DEVELOPING A SEED SUPPLY

A robust and stable supply of genetically appropriate seed is needed to meet restoration demands in response to expanding environmental stressors from land degradation, invasive species, and climate change. Restoration success is, in part, predicated on applying the right seed in the right place, at the right time (PCA 2015). Developing a restoration seed supply involves coordination across many partners in all steps of the process: from conducting wildland collections to propagating materials in nurseries and agricultural fields to eventual seeding or outplanting at restoration sites. Appropriate protocols for preserving genetic diversity and adaptive capacity should be in place (Erickson and Halford 2020) and seed origin should be documented for certification purposes and other seed planning considerations.

Seed Sourcing.

Seed sourcing can influence restoration outcomes due to local adaptation (Custer et al. 2022), landscape genetic patterns (Massatti et al. 2020, Shryock et al. 2021) and differing ability to adapt to current and future climate conditions (Bucharova et al. 2019). However, there has been relatively little research evaluating seed sourcing strategies in actual restoration settings where many additional factors influence performance (Pizza et al. 2023). While non-local sources can perform well in meeting initial restoration goals such as establishment and productivity (Pizza et al. 2023), evidence of local adaptation and its influence on restoration outcomes can take decades to emerge for long-lived species (Germino et al. 2019). Also, plants have coevolved with interacting organisms, such as pollinators and herbivores, that can exhibit preferential behavior for local materials (Bucharova et al. 2016, 2022).

Empirical seed transfer zones have not been developed for smooth desertdandelion. The Desert Southwest Provisional Seed Zones (PSZs) may be used to plan seed sourcing in absence of species-specific information (Figure 9). The Desert Southwest PSZs use twelve climatic variables that are known to drive local adaptation in contrasting native species to define areas within which plant materials may be transferred with higher probability of successful establishment and reduced risk of introducing maladapted ecotypes (Shryock et al. 2018). Overlaying PSZs with Level III ecoregions can serve to further narrow seed transfer by identifying areas of both climate similarity inherent in the PSZs and ecological similarity captured by the ecoregion, namely vegetation and soils. Within the PSZs and ecoregion areas, further site-specific considerations such as soil, land use, species habitat and microclimate affinities, and extant plant community may be relevant to seed sourcing decisions.

The USGS Climate Distance Mapper Tool incorporates the Southwest Deserts Seed Transfer Zones with climate models and can serve to guide seed sourcing according to current and projected climate conditions.

Commercial Seed Availability and Germplasm Releases.

Smooth desertdandelion is not widely available for purchase from large-scale commercial seed vendors. There are no conservation plant releases of smooth desertdandelion.

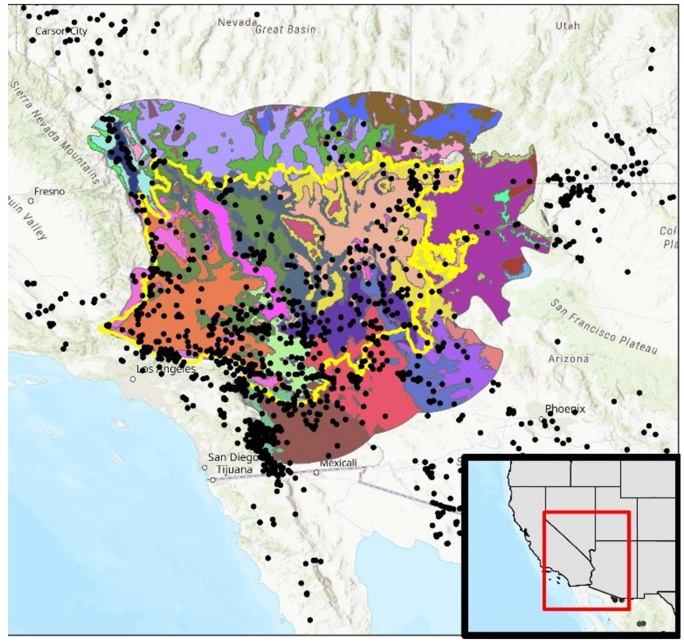

Figure 9: The distribution of smooth desertdandelion across the Desert Southwest Provisional Seed Zones (Shryock et al. 2018). Occurrences (black dots) are based on georeferenced herbarium specimens and verified observations (SEINet 2023). The Mojave Basin and Range Level III ecoregion (yellow outline) is buffered up to 100 km in all directions. PSZs do not always extend a full 100 km beyond the Mojave ecoregion.

Wildland Seed Collection.

Wildland seed collection involves visiting naturally occurring populations of target species to provide source seed for propagation, restoration, and research. Ethical practices are intended to prevent overharvesting by limiting harvests to no more than 20% of available seed (BLM 2021). However, in arid regions and under drought conditions, it may be best to adapt this guidance to collect no more than 10% of available seed due to limited regeneration and low-density populations (CPC 2023). Several practices are in place to ensure proper genetic diversity is captured from the source population. These include collecting from the entire population uniformly, sampling a diversity of phenotypes and microclimates, and collecting in various time windows to capture phenological and temporal diversity (BLM 2021). Seed

Collection Timing.

In the Mojave and Sonoran Deserts, smooth desertdandelion is typically collected between March and June with the majority of collections occurring in April and May (BLM SOS 2022).

Collection Methods.

Mature dry fruits can be collected by hand. Seed can quickly disperse from seed heads making the timing of wildland collection difficult. Mesh or organza bags can be fixed around each flower to avoid losing seeds to the wind. However, bagging can prevent pollination and be quite labor intensive (Asbell 2023, personal communication). See [Seed Harvesting](#) for more information on methods to collect seed in agricultural settings that may apply to wildland collections.

Post-Collection Management.

Immediately following collection, seeds should be properly managed to avoid damage or declines in viability during transport and temporary storage. Seed should be dried and ventilated to prevent molding (Pedrini and Dixon 2020). Ventilation can be achieved by collecting and storing seed in breathable containers, such as paper or cloth bags.

To dry material before storage or processing, spread it in a single layer on trays or newspaper indoors in a well-ventilated room, or outdoors in a shaded area (BLM 2021). Collected material should be visually inspected for seed-predating insects (Pedrini and Dixon 2020). If seed predation is observed, consider fumigation with No-Pest Strips. After collection, prevent exposure to excessively hot or cold temperatures during transportation and temporary storage by keeping seed in a dry, insulated container (e.g., a cooler) in a shaded area while in the field (BLM 2021).

Seed Cleaning.

Once dry, seed can be cleaned by rubbing material over a small screen or rubber mat to break off pappus followed by running it through a blower at 1.0 speed (Wall and MacDonald 2009).

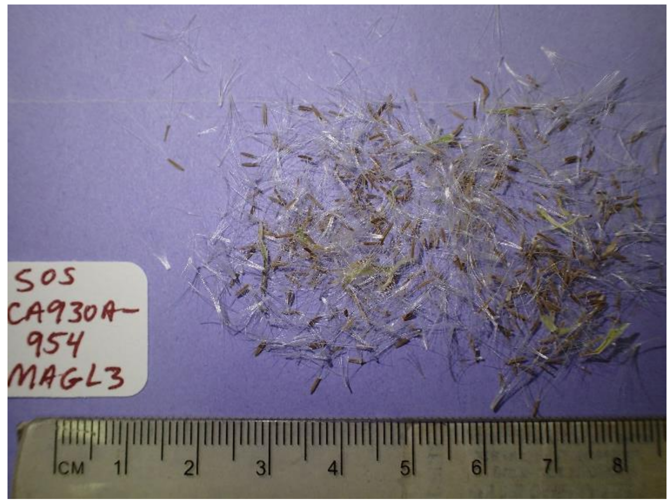

Figure 10: Collected material of smooth desertdandelion, scale shown in centimeters. Photo: BLM SOS CA930A

Seed Storage.

No species-specific storage protocols or information on seed longevity were found in the literature or through personal communication.

In general, seeds should be stored in cool and dry conditions, out of direct sunlight, to maintain viability. Optimal conditions for medium-term storage of orthodox seeds (up to 5 years) are 15% relative humidity and 15°C (59°F). For long-term storage (> 5 years), completely dried seeds should be stored at -18°C (0°F) (De Vitis et al. 2020, Pedrini and Dixon 2020).

Seed Testing.

After collection, a representative sample of each seed lot must be tested in an appropriate seed lab to ensure purity and germination meet minimum standards defined by the Association of Official Seed Analysts (AOSA) (2016) and species standards from state-level certification programs as available. A set of "principles and standards for native seeds in ecological restoration" (Pedrini and Dixon 2020) outlines further guidelines specific to native plants, including procedures for obtaining representative samples of seed lots and incorporation of dormancy measures into seed testing and labels.

The pure seed unit—a combined unit of seed and attached structures that is classified as pure seed as opposed to inert material—for smooth desertdandelion is defined by AOSA as an "intact achene, with or without one or more of [several] structures…provided a true seed with some degree of embryo development can be detected" (AOSA 2016).

Although *Malacothrix* is not specifically included in the AOSA tetrazolium testing protocols for the Asteraceae family, similar seed morphology with included genera suggests the same methods would apply to determine seed viability. These methods involve imbibing seeds overnight at 20-25 °C (68-77 °F), then cutting seeds longitudinally and placing them in a 0.1% tetrazolium solution for 6 hours to overnight at 30-35 °C (86-95 °F). Viability can then be quantified by assessing the percentage of seeds with embryos that are either evenly stained or have more than half of their cotyledons stained (AOSA 2010).

Wildland Seed Yield and Quality.

Wild-collected smooth desertdandelion seed is generally high quality, with an average of 92% fill, 94% purity and 89% viability indicated by tetrazolium tests across 21 Seeds of Success collections (BLM SOS 2022, Table 2). Wild collections contain an average of over 1,875,000 pure live seeds per pound (BLM SOS 2022, Table 2).

Table 2: Seed yield and quality of smooth desertdandelion seeds collected in the Mojave Basin and Range Ecoregion, cleaned by the Bend Seed Extractory, and tested by the Oregon State Seed Laboratory or the USFS National Seed Laboratory (BLM SOS 2022). Fill (%) was measured using a 100 seed X-ray test. Viability was measured using a tetrazolium chloride test.

	Mean	Range	Samples
Bulk weight (lbs)	0.27	0.02-0.77	21
Clean weight (lbs)	0.033	0.0011-0.19	21
Purity (%)	94	80-99	21
Fill (%)	92	32-99	21
Viability (%)	89	25-98	21
Pure live seeds/lb	1,875,538	907,200-2,428,416	21

Wildland Seed Certification.

The Association of Official Seed Certifying Agencies (AOSCA) sets the standards for seed certification and provides guidance on production, identification, distribution, and promotion of all certified seed, including pre-varietal germplasm. Pre-varietal germplasm (PVG) refers to seed or other propagation materials that have not been released as varieties (AOSCA 2022). Pre-varietal germplasm certification programs for Source Identified materials exist in several states encompassing the Mojave Desert ecoregion including California (CCIA 2022), Utah (UTCIA 2015), and Nevada (NDA 2021). Arizona does not have a PVG certification process at this time. Source Identified (SI) germplasm refers to seed collected directly from naturally occurring stands (G0), or seed grown from wildland-collected seed in agricultural seed increase fields (G1-Gx) that have not undergone any selective breeding or trait testing. These programs facilitate certification and documentation required for wildland-collected seed to be legally eligible for direct sale or seed increase in an agricultural setting. Certified SI seed will receive a yellow tag, also referred to as an SI-label, noting key information about the lot including the species, the generation of seed (G0-Gx), source location, elevation, seed zone, etc. (UTCIA 2015, NDA 2021, CCIA 2022).

Wildland seed collectors should be aware of documentation required for seed certification. The Seeds of Success data form and protocol (BLM 2021) include all appropriate information and procedures for site documentation and species identification verification to meet certification requirements for wildland sourced seed. Seed certifying agencies may also conduct site inspections of collection locations prior to certification—specific requirements for inspections vary by state and are at the discretion of the certifying agency.

AGRICULTURAL SEED PRODUCTION

Smooth desertdandelion has not been produced in large-scale agricultural seed increase fields, but small-scale trials to grow this species from Mojave Desert sources are underway.

Agricultural Seed Field Certification.

As with wildland source seed (see Wildland Seed Certification section), seed grown in an agricultural seed increase field must also be certified by an official seed certifying agency, where programs exist. Field grown seed is also certified and labeled as Source Identified (SI), as long as it has not undergone selective breeding or testing. Seed field certification includes field inspection, seed testing for purity and germination (see Seed Testing section), and proof of certification for all source or parent seed used to start the field (AOSCA 2022). The SI-label or "yellow tag" for seed from a seed increase field denotes information about source seed, field location, and generation level (G1-Gx) indicating if there is a species-specific limitation of generations allowed to be grown from the original source (e.g., in a species with a three-generation limit, G1/G3, G2/G3, G3/3) (AOSCA 2022). Fields must be free of any prohibited noxious weeds. Restricted noxious weeds and common weeds difficult to separate must be controlled. Fields may be refused certification due to unsatisfactory appearance caused by weeds, poor growth, poor stand, disease, insect damage, and any other condition which prevents accurate inspection or creates doubt as to identity of the variety.

Table 3 outlines the pre-variety germplasm certification standards for smooth desertdandelion seed in the state of California with a minimum of 0.5 oz sample size to be submitted for testing (CCIA 2022). The Nevada and Arizona Departments of Agriculture do not specify standards for PVG crops. The Utah Crop Improvement Association does not specify standards for PVG crops but may apply standards of similar species or crop groupings (UCIA 2023).

Isolation Distances.

Sufficient isolation distances are required to prevent cross-pollination of smooth desertdandelion with different conspecific sources or other *Malacothrix* species. Table 4 summarizes the isolation distances required for PVG certification in both Utah and California. California standards are described specifically for smooth desertdandelion (CCIA 2022), while the Utah standards are general for outcrossing annual species (UCIA 2023). Nevada and Arizona do not specify these standards for Source Identified PVG seed. The distances recommended by California (15-60 feet) may be insufficient to prevent pollinator-facilitated gene flow between different Source Identified smooth desertdandelion crops and related species.

Table 3: Pre-varietal Germplasm (PVG) standards for seed analysis results of smooth desertdandelion seed increase crops in California.

Factor	G1	G2	G3 to G10
Pure Seed (minimum)	30%	30%	30%
Inert Matter (maximum)	30%	30%	30%
Total Other Crop Seed (maximum)	0.2%	0.3%	0.5%
Weed Seed (maximum)	0.2%	0.3%	0.5%
Noxious Weed	None	None	None
Germination and Hard Seed (minimum)	60%	60%	60%

Table 4: Crop years and isolation distance requirements for pre-varietal germplasm crops of smooth desertdandelion. CY= crop years, or the time that must elapse between removal of a species and replanting a different germplasm entity of the same species on the same land. I= isolation distance, or the required distance (in feet) between any potential contaminating sources of pollen.

State	G1		G2		G3+	
	CY	I	CY	I	CY	I
Utah	3	900-600	2	450-300	1	330-165
California	5	60	5	30	2	15

Site Preparation.

Fields should be as weed-free as possible prior to sowing or transplanting smooth desertdandelion seeds or plugs. Site preparation to reduce undesirable vegetation should be planned and implemented well in advance of field establishment (USDA NRCS 2004). If fields are uncultivated or fallow and have perennial or annual weeds, one or more years of intensive cultivation (i.e. cover cropping) and herbicide treatment may be necessary (USDA NRCS 2004). After managing undesirable species, final seedbed preparation can include shallow tilling followed by packing to promote a finely granulated, yet firm seedbed that allows soil to seed contact, as well as facilitation of capillary movement of soil moisture to support seedling development (USDA NRCS 2004).

Seed Pre-treatments.

Smooth desertdandelion likely needs cold and wet conditions for germination (Plath 2023, personal communication). Growers at the Mojave Desert Land Trust successfully germinated smooth desert dandelion seed in both direct, in-ground seeding and in plug containers with no pre-treatments (Asbell 2023, personal communication). In this case, seeds were sown in mid-December and were exposed to winter conditions.

Seeding Techniques.

In a trial to compare direct seeding with plug transplanting, growers at the Mojave Desert Land Trust (MDLT) found that plug transplants resulted in more uniform fields, higher flower production per plant, and higher numbers of seeds per head compared to direct seeding (Table 5; Asbell 2023, personal communication).

For the direct seeding, 0.4 grams of seed were sown in a 100 ft^2 area in mid-December by first scuffing the soil with fingertips then broadcasting the seed over the area, and smoothing the soil over the seed, avoiding burying the small seeds too deeply (Asbell 2023, personal communication).

Growers at the Tucson Plant Materials Center (PMC) established a smooth desert dandelion field from plugs grown in a greenhouse (Dial 2023, personal communication). Prior to transplanting plugs, weed fabric was laid out and holes were cut into the cloth every 12-14" to plant the plugs into (Dial 2023, personal communication).

Establishment and Growth.

In the MDLT trials described above, plugs were grown in a greenhouse and transplanted two months after sowing. There was about 80% survivorship of transplanted plugs. The transplants flowered in the field two months after transplanting (four months after sowing).

For the directly seeded plot, 164 seedlings germinated, of which 141 plants survived to produce seed (85% survivorship). Plants flowered about four months after sowing. Direct sowing resulted in more variable plant size and spacing in the field compared to the plug transplants, which were more uniform (Asbell 2023, personal communication).

No metrics for establishment and survival were available from the Tucson PMC trials (Dial 2023, personal communication).

Table 5: Results of a trial to compare plug transplanting to direct seeding for smooth desertdandelion at the Mojave Desert Land Trust. # Plants = total number of plants established; flwrs/plnt = average number of flowers produced per individual plant; sds/hd = average number of seeds per flower head; total seeds= number of seeds harvested from 100 ft^2 trial plot.

Method	# Plants	Flwrs/ plnt	Sds/ Hd	Total Seeds
Plug	74	77	155	885,000
Direct Seed	141	22	132	422,000

Weed Control.

Generally, weeds can be manually removed or carefully spot-sprayed with a non-selective herbicide as they emerge. There are limited number of herbicides registered and labeled for use on native plant crops. See the Native Seed Production guide from the Tucson Plant Materials Center (USDA NRCS 2004) for further details on weed management in native seed production fields. In smaller fields, hand rogueing weeds can be sufficient (Hagman 2023, personal communication).

Pest Management.

Small mammal (either rabbit or squirrel) herbivory was an issue for a desert dandelion crop at the Tucson PMC (Dial 2023, personal communication) and the MDLT (MDLT 2022). The entire crop at Tucson PMC was decimated by herbivory and no additional seed was available to replant the field. Chain link or chicken wire fences can help deter small mammal herbivory.

No specific information on smooth desert dandelion's pest susceptibility or management was described in literature or through personal communication.

Pollination Management.

Growing native plants in or near their native range increases the likelihood that compatible pollinators will be able to find and pollinate the crop (Cane 2008).

Since smooth desertdandelion relies on native solitary bees, growers can consider creating nesting opportunities adjacent to or within the field perimeter with downed woody material or crafted bee boxes (Cane 2008, MacIvor 2017).

Irrigation.

For the trials at MDLT, all plots were watered once per week for one hour using drip with inline emitters spaced 12” apart. A slow leak in the irrigation system during the trial caused uneven water application, with downhill rows receiving more water than uphill rows. Repeating the trial with repaired irrigation could yield different results (Asbell 2023, personal communication).

Many growers apply uniform watering techniques regardless of species due to their set infrastructure and labor resources. For example, at the Tucson Plant Materials Center, where smooth desertdandelion has been grown, all fields are watered with flood irrigation (Dial 2023, personal communication). After seeding, fields are irrigated to maintain a moist soil surface and avoid soil crusting that would interfere with germination. Once plants are established, fields are flooded approximately every four weeks during the growing season. Irrigation frequency will depend on heat and precipitation levels and may be as frequent as every two weeks during the hottest part of the year to avoid stressing plants and lowering seed yield (Dial 2023, personal communication).

Other growers administer water via drip irrigation and find flood irrigation does not adequately penetrate into soil, resulting in significant evaporation in aridland farm settings (Hagman 2023, personal communication).

Seed Harvesting.

Proper timing and methods for harvesting smooth desertdandelion seed are challenging. Seed heads open and release seed in the afternoon, after which seeds can quickly blow away in the wind.

At the Tucson Plant Materials Center, plugs were planted into holes in a weed barrier cloth covering the ground to with seed harvest since fallen seeds could be harvested off the cloth instead of the bare ground. However, no harvest was accomplished due to severe herbivory that destroyed the crop (Dial 2023, personal communication).

In trials at the Mojave Desert Land Trust, growers attempted to collect the heads at different stages prior to them being completely open (Asbell 2023, personal communication). The optimal timing, for collecting viable seed befo re it blows away, was identified as when the seed head reaches maturity prior fully opening - indicated by some visible pappus at the tip of the head. Since new seed heads ripen daily, harvests must be done daily at an optimal time to collect the seed before it is released (Asbell 2023, personal communication). The window for collection was around 4 hours (usually between 10am and 2pm), shorter if it was windy. In the MDLT trial, seeds were collected from April through June (Asbell 2023, personal communication).

MDLT growers also tried bagging unripe seed heads using tea bags and organza bags. These trials were generally unsuccessful (Asbell 2023, personal communication). The tea bags were too heavy and broke the stems of the plants. The organza bags were not effective at retaining seeds, which worked their way out of the bag.

Since there can be over 100 flowers on a single plant and they are pollinated and ripen at different intervals, bagging each flower after it is pollinated is considered too labor intensive. Bagging could also prevent pollination if done too early (Asbell 2023, personal communication).

Scaling up these methods to larger scale production would likely prove difficult. Further research is needed on effective and economical methods to harvest this species in agricultural production settings.

Figure 11: Material collected to determine optimal harvest time prior to wind dispersal for smooth desertdandelion seed. The percentage of filled seed in the buds pictured (from left to right) is 10%, 0%, 30%, 100%, and 100% in both the upper and lower photos. Photo: Madena Asbell

Seed Yields and Stand Life.

The stand life for an annual will be one year for the target generation class. The trials at MDLT yielded a maximum of approximately 885,000 seeds from a 100 ft2 area (Asbell 2023, personal communication).

NURSERY PRACTICE

Smooth desertdandelion was propagated in a nursery at MDLT for the seed increase trials described above. Seed was sown in mid-December into 60-cell trays (cavity dimensions 1.7″ x 2.9″) at a rate of five to ten seeds per cell. After approximately two months in the greenhouse, they were transplanted outdoors into the seed increase trial plots (Asbell 2023, personal communication).

Nursery propagation is not commonly practiced for annual species, except in some cases for small-scale seed increase or starting seedlings from limited seed stock in preparation for agricultural seed production (Brooks and Gault 2023, personal communication).

REVEGETATION AND RESTORATION

There are no documented examples of smooth desertdandelion use in restoration projects. However, some of the methods for establishing seed production plots for smooth desertdandelion could apply to wildland restoration.

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RESOURCES

AOSCA NATIVE PLANT CONNECTION

https://www.aosca.org/wp-content/uploads/Documents/AOSCANativePlantConnectionBrochure_AddressUpdated_27Mar2017.pdf

BLM SEED COLLECTION MANUAL

https://www.blm.gov/sites/default/files/docs/2021-12/SOS%20Technical%20Protocol.pdf

OMERNIK LEVEL III ECOREGIONS

https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-continental-united-states

CLIMATE SMART RESTORATION TOOL

https://climaterestorationtool.org/csrt/

MOJAVE SEED TRANSFER ZONES

https://www.sciencebase.gov/catalog/item/5ea88c8482cefae35a1faf16

MOJAVE SEED MENUS

https://rconnect.usgs.gov/MojaveSeedMenu/

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