

Identifying and Managing Sahara Mustard

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Sahara mustard (*Brassica tournefortii* Gouan) is native to North Africa, the Middle East, and Mediterranean lands of southern Europe. It was first collected in the United States in California in 1927. It is now found in southern Nevada, southern California, Arizona, New Mexico, and west Texas. A large number of these plants began appearing around Lake Mead National Recreation Area in Arizona and Nevada in 2000. It is imperative that further establishment of this invasive weed be prevented and that existing plants be eliminated.

Identification

Sahara mustard, also commonly known as wild turnip, African mustard, and Asian mustard, is a member of the mustard family (*Brassicaceae*). It is an erect annual herb that can grow from four to forty inches tall, or rarely more (Fig. 1). The stems branch from the base of the plant and have rough, stinging hairs that make them painful to touch. The plants smell of cabbage or turnips when crushed.

The basal rosette of leaves grows up to three feet in diameter in favorable environments. The basal leaves can be three to twelve inches long. The lower leaves are arranged in a rose-like cluster and have lobes with rounded tips. The stem leaves are much smaller and have bristly, stiff hairs on both sides. They are oblong or linear with entire or toothed margins. Leaves are pinnately divided with an enlarged terminal lobe and smaller lateral lobes. Leaves, which are mostly basal, decrease in size further up the stem.

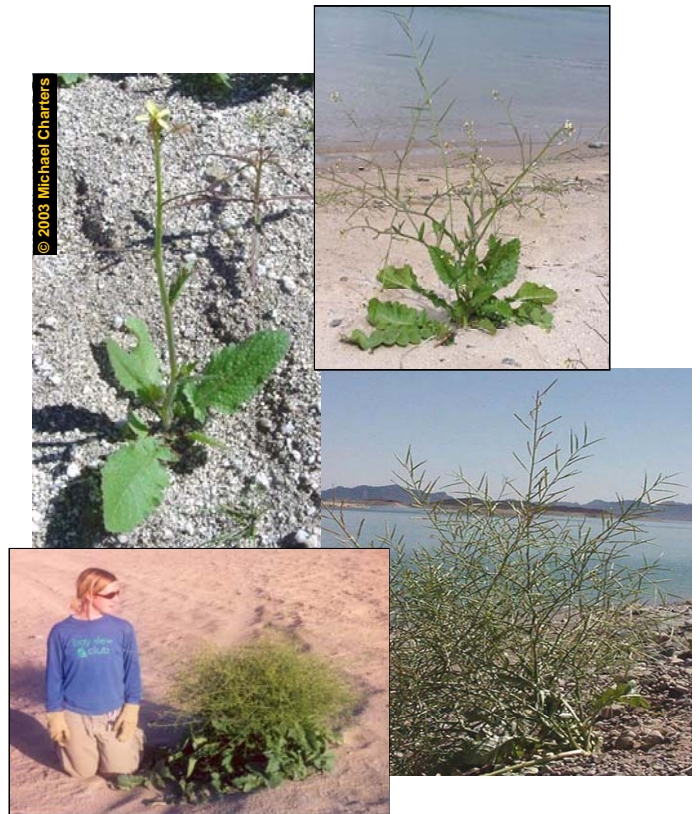


Figure 1. Various sized Sahara mustard plants.

Sahara mustard's flowers are small, less than one-quarter inch, with four oblong, pale yellow petals arranged in the shape of an X (Fig. 2). They are bractless with smooth or lightly hairy sepals. The flower petals are longer than the sepals and spread away from the stem. The plant's flowers or fruits may appear as early as December or January. As a winter annual in southern Nevada, most plants have fruited and are dead by April or May.



Figure 2. Although showy in this photograph, Sahara mustard flowers are small and pale yellow. © Michael Charters

Sahara mustard fruits are narrow seed capsules (siliques) that break open when mature (dehiscent) and disperse seed, Fig. 3. Each silique has a noticeable beak at its tip. The seeds are only 0.04 inch (1 mm) in diameter, the smallest of any *Brassica* species. They are reddish brown, spherical, and ribbed. The mucilaginous coating of the seeds, makes them both very sticky when wet and waterproof when swollen by water, which allows them to survive in a dormant condition for up to two months in or under water and facilitates their spread during rainy conditions.

Well developed plants may produce between 750 and 9,000 seeds. Seed of other *Brassica* species remain viable for several years, although it is not known whether this is true of Sahara mustard seed. However, seed kept for three years under room temperatures in the lab were able to germinate. Sahara mustard may be self-fertile because fruit set is nearly 100 percent on most plants.

In the laboratory, 90 to 99 percent of Sahara mustard seeds tested germinated within 48 hours after being wetted. Seeds germinated at temperatures between 61 °F (15 °C) and 90°F (32 °C) in the laboratory. Tests of seeds wetted and maintained at temperatures lower and higher than these did not germinate. Germination was 90% or greater at temperatures between 61 °F (16 °C) and 82 °F (28 °C). Consequently, germination should be expected in the field

following rain when daily temperature occurs within this range. Optimal germination should typically occur from February to April in southern Nevada, from April to June in northwestern Nevada, and May through early summer in northern Nevada. In southern Nevada, seeds have germinated repeatedly in the same area following rains when temperatures have been in this range. Germination has not been observed to occur after rainfall during hot summer months in southern Nevada. Germination during the hot summer months may be inhibited by light (long day length), high temperatures, and/or lack of persistent moisture.

Habitat

Sahara mustard typically inhabits areas of low elevation, but it has been found as high as 3,300 feet at Lake Mead National Recreation Area. This weed has spread across deserts in southwestern North America, including southern Nevada. It particularly thrives in sandy or gravelly soils in disturbed and undisturbed areas. It often forms almost pure stands on sandy fields,



Figure 3. A fruit and a wet seed surrounded by a sticky, mucilaginous gel.

beaches, and dunes. It is most common in wind-blown sand deposits and in disturbed sites, such as roadsides and abandoned fields. Sahara mustard is scarce on alluvial fans and rocky hillsides as of yet, but it is becoming more common and is capable of growing in these areas.

Impact

Sahara mustard is particularly threatening because it does not require soil disturbance to be invasive. Sahara mustard plants growing early in

the season may dominate available soil moisture. This may adversely affect native annuals starting growth a little later in the season.

Sahara mustard is thought to increase fuel loads and fire hazard in desert scrub and coastal sage scrub. In addition, it may establish from a soil seed bank after fire, but this is yet to be determined.

Rodents cache seeds and may be capable of moving seeds up to 100 meters from their source. Uneaten caches are capable of germinating, thus spreading the plants. These caches are often found in washes, wash banks, berms, and sandy areas. Seeds can also be spread by water and wind. Dry plants can break off at ground level and tumble across the landscape in the wind, spreading seed and infesting new areas.

Sahara mustard seed may be dispersed long distances during wet weather. The mucilaginous gel that forms on seeds in contact with water can cause seeds to stick to many surfaces, such as animals, vehicles, and people. This could facilitate spread. Plants can be blown into water bodies, such as lakes and rivers, and can float on water to new areas. Seeds have been shown to be capable of germinating after being in or under water for up to two months.

Sahara mustard can form dense stands and potentially crowd out native annuals. The density of plants per square foot may fluctuate with annual climate, soil type, available soil moisture, and fire history. Because Sahara mustard is drought tolerant, long, dry periods that may kill other plants, might allow Sahara mustard to increase its stand. This may or may not have been the case during a drought in Riverside County from 1989 to 1991 when red brome cover on a dry southern exposure declined, and the population of Sahara mustard increased by nearly 35 times. Conversely, hot spells or fires may decrease Sahara mustard density by causing the plants to flower and fruit early. Densities equivalent to as high as three million plants per acre have been recorded at Lake Mead National Recreation Area.

Currently, it appears that most birds and mammals do not forage on this plant. The highly nutritious and caloric seeds, however, are eaten by rodents and some birds.

Management Methods

Experiments to find effective methods of Sahara mustard control are ongoing. Plants may

be controlled if quick action is taken before a seed bank in the soil is established.

Prevention: The best control method for any invasive plant is prevention. People must be made aware and given the tools for early identification in order to prevent the ingress and establishment of alien species in new areas. If Sahara mustard is found, eliminate it immediately. Do not allow it to go to flower and produce seed. Minimize soil disturbance by vehicles, equipment, or other activities to prevent its spread by these vectors. This plant spreads by seed, so do not drive vehicles, move animals, or walk through infested areas, especially following a rain. It is particularly important to avoid moving mud and soils from infested areas. Contaminated equipment used to fight wildland fires, construct and maintain utility lines, build and maintain roads—any equipment, along with recreational vehicles (SUVs, ATVs, dirt bikes, etc.) may be put on trailers and moved great distances. Unless the equipment and trailer are properly cleaned before moving from infested lands, they may transport Sahara mustard seed hundreds of miles to infest new areas.

Unfortunately, rodent caching of Sahara mustard seed into disturbed areas may be a significant way this plant is spread, over which there are not many management options. Controlling the animals may or may not be possible or desirable. Of course, monitoring the area for caches and then treating them accordingly is important.

Mechanical Control: Hand pulling plants is effective in reducing the population, especially if done before a seed bank has been established. For best results, return to the site several times over the season, especially if there have been repeated rainfall events, and eliminate any new plants.

Hand hoeing is also very effective in large stands of plants if done when the plants are in the rosette or early stages of flowering, particularly on sandy or gravelly sites. Weed whipping and mowing alone are not recommended because the plants will simply regrow flower and fruit stalks.

Planned burning will probably not be effective due to Sahara mustard's ability to survive long periods of harsh conditions in soil seed banks. Fires do cause high seed losses; however, plants grow back rapidly following fire. Furthermore, fire in desert environments may harm native plants,

seed banks, and soil organisms, and increase the spread of alien grasses.

Cultural Control: Grazing is not expected to contain the spread of Sahara mustard because as yet, animals do not appear to readily eat it and the plants can establish rapidly from the seed bank. It is possible that goats could be trained to eat Sahara mustard, but to our knowledge this has not been done. Burros do eat the plant, but not enough to make a difference. Experiments need to be undertaken in order to determine the effects of grazing.

The effect of revegetation on the stand density of Sahara mustard also needs to be investigated. A dense cover of annual or perennial grasses may restrain Sahara mustard germination, establishment and long term persistence in an area.

Biological Control: There are currently no biological control agents for Sahara mustard. Due to the plant's close relationship to many significant crops in the mustard family, such as broccoli, cauliflower, brussel sprouts, and canola, it will be difficult to find an agent that will control Sahara mustard without damaging these crops.

Chemical Control: Early applications of chemicals may control Sahara mustard due to its extremely early development. Applications should be particularly effective if started before native species have begun to develop. Applying Remedy® or Garlon® (triclopyr) at a 2% concentration killed plants in the rosette and early flowering stage at Lake Mead National Recreation Area. However, if the plants have already produced fruits, it is wise to hand-pull and remove them from the site. Green fruits may be capable of ripening in the field from uprooted and /or chemically treated plants to produce viable seed. It is unknown if treatment with triclopyr prevents seed ripening in green fruits or decreases the viability of already ripened or potentially ripened seed.

Tests are currently being conducted to determine whether other chemicals will effectively control Sahara mustard. So far, tests have shown that applications of Roundup® (glyphosate) are inconclusive. However, weed whipping followed by applications of glyphosate effectively kills plants.

In Australia, Sahara mustard is considered resistant to Group B herbicides, which includes chemicals such as chlorsulfuron, imazethapyr, and flumetsulam. These herbicides inhibit

acetolactate synthase (ALS), and are powerful inhibitors of root growth. They are usually applied pre- and post-emergence. These herbicides do not effectively control Sahara mustard plants in Australia, but their effectiveness in the United States has not been determined.

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