USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

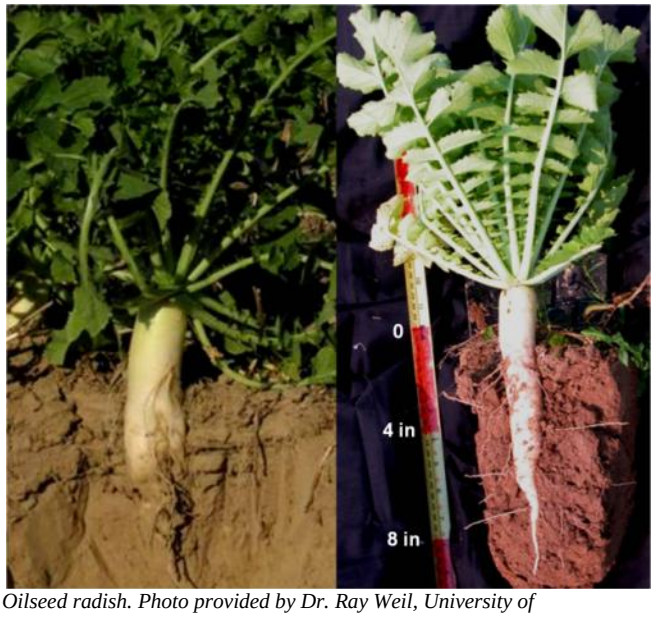
Plant Guide

OILSEED RADISH

Raphanus sativus L.

Plant Symbol = RASA2

Contributed by: USDA NRCS Booneville Plant Materials Center, Arkansas



Oilseed radish. Photo provided by Dr. Ray Weil, University of Maryland.

Alternate Names

Common Alternate Names: forage radish, fodder radish, tillage radish®, radish ripper, daikon, Japanese radish
Scientific Alternate Names: *Raphanus sativus* var.*oleifer* Stokes, *Raphanus sativus* L. *ssp.* Oleiferus, *Raphanus sativus* L. var. *oleiformis* Pers.

Uses

Cover Crop: Oilseed radish is used as a cover crop, or a crop grown specifically to maintain cropland soil quality, fertility, and productivity (Magdoff and Van Es, 2009). Typically, cover crops are not harvested and are terminated on the surface or otherwise incorporated into soil before they mature (Magdoff and Van Es, 2009). Cover crop species generally limit soil erosion because they provide cover to the soil when the soil would normally be fallow.

Oilseed radish is a fall cover crop planted in early fall/late summer or after harvest of the primary crop. Planting occurs after the harvest of primary crops such as wheat, rye, early potatoes, pickling cucumbers, snap beans, or celery (Ngouajio and Mutch, 2004). Oilseed radish can also be aerial seeded into standing corn, soybean, or cotton prior to harvest.

Oilseed radish develops a unique taproot that reaches depths of six feet. The upper 12-20 inches of the taproot thicken and can grow to 2 inches in diameter (Weil et al., 2006). This deep rooting growth habit is capable of treating multiple resource concerns on cropland, such as:

Soil Compaction: The thick taproot penetrates compacted layers better than other commonly used cover crops such as rye (*Secale cereale* L.) (Williams and Weil, 2004). The root decomposes in the spring, leaving large, deep holes in the soil. These holes enable water, air, and primary crop roots to penetrate the soil in the summer when the soil is dry and hard (Weil and Williams, 2003). Planting oilseed radish can be a no-till alternative to deep tilling or mechanical ripping (Williams and Weil, 2004).

Excessive nitrate leaching: The deep taproot can scavenge nitrogen in the soil left by the previous crop. Oilseed/forage radish cover crops can absorb 100 to 150 lb/acre of nitrogen (Weil et al., 2006). Many cover crop species are nitrogen scavengers, but the roots of oilseed radish are able to absorb nitrogen at greater depths, preventing it from leaching into groundwater. Oilseed radish fields had lower levels of nitrate in soil gravitational water than fields of red clover, ryegrass, and a fallow field (Isse et al., 1999). Oilseed radish roots absorb nitrogen deep in the soil where the primary crop cannot access it. This trapped nitrogen becomes available to the next crop when the plant decomposes in the spring. Growing oilseed radish can act as a fertilizer for the next crop in the rotation by recycling nitrogen that would otherwise be lost through leaching (Kristensen and Thorup-Kristensen, 2004).

Weed Management: Under favorable conditions, oilseed radish seedlings can emerge as soon as 3 days after planting, and provide full canopy cover to shade out weeds in 3-4 weeks (Weil et al., 2006). Studies in Michigan found that oilseed radish reduced weed biomass by 4,000 lb/acre when compared to a fallow site (Snapp and Mutch, 2003). Biomass decomposes quickly and leaves the seedbed ready for planting, without the need to till or remove leftover residue.

Pest Management: Like other plants in the mustard family (Brassicaceae), the roots of oilseed radish exude chemicals that help suppress soil pests such as nematodes. These chemicals, called glucosinolates, discourage infestations of soil-borne diseases (Ngouajio and Mutch, 2004). Breakdown of these chemicals in the soil produces

compounds similar to the commercial soil fumigant Vapam® (metham sodium) (Ngoujio and Mutch, 2004).

Roots of oilseed radish trap sedentary beet cyst nematode (BCN) (*Heterodera schachtii)* and prevent reproduction (Budahn et al., 2009). This nematode can damage broccoli, cabbage, and other crops in the mustard family.

The use of oilseed radish for control of soil pests is still under investigation. Integration of this crop should only be part of an integrated pest management (IPM) system and will not completely control pests when used alone.

Oilseed radish roots (4-5 inches in diameter) remain in soil after winterkill in Arkansas. Photo provided by Dr. Larry Purcell, University of Arkansas.

Forage: Oilseed radish produces up to 2 ton/acre of high quality above ground biomass (Dean and Weil, 2009). Forage is highly digestible and can be used as early and late season grazing by all classes of livestock (Ngouajio and Mutch, 2004). Mix oilseed radish with a grass species or supplement with hay to minimize bloating and other animal health disorders in cattle (McCartney et al., 2009).

Oil Production: Seeds of this species have high oil content. Oil extracted from the seeds has been tested in Brazil and found to be an acceptable source of biodiesel (De Andrade Avila and Sodre, 2012).

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Weediness

To prevent oilseed radish from becoming a weed pest, kill the crop before plants produce seed. Seeds may remain viable in the soil for multiple growing seasons, and can germinate when the cash crop is being grown. This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at http://plants.usda.gov/.

Please consult the Related Web Sites on the Plant Profile for this species for further information.

Description

General

Oilseed radish is a coarse winter annual in the Brassicaceae (or Cruciferae) family with stiff, straight hairs near the base of the leaves (Radford et al., 1987). Leaves are deeply dissected in shape and grow in a basal rosette to 2-3 feet tall (SARE, 2010). Seed stalks elongate from the rosette. Flowers emerge in the spring. They have four petals and are pink, white, or lavender in color (Radford et al., 1987). Fruits are called siliques and look like small bean pods. Siliques have two valves that separate seeds by a thin, papery septum (Harris and Harris, 2006).

Some confusion exists as to the exact taxonomic classification of oilseed radish. Some literature separates forage radish and oilseed radish as different varieties with oilseed radish having a stubbier, more branched root and a greater degree of winter hardiness than forage radish (Weil et al., 2006). However, varieties of radish can readily hybridize and true distinctions are poorly understood. Recommendations for management and use are generally the same for most varieties (Weil et al., 2006).

The Brassicaceae family also produces edible crops such as broccoli and cabbage. Oilseed radish differs from typical radish because it develops a thick, white taproot that can grow 1-2 inches in diameter and up to 1 foot in length (Magdoff and Van Es, 2009). Plants give off a foul rotten egg-like odor when they decompose in the spring (Weil et al., 2006).

Distribution:

Radish varieties have been domesticated since ancient times and were originally cultivated in China (Navazio, 2007). Oilseed radish was developed from selections of wild and cultivated radish varieties for oil and food production, but does not exist in the wild (Magdoff and Van Es, 2009). It is widely distributed around the world in cultivation, including the United States and Canada.

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Ethnobotany

Oilseed radish, also called Japanese radish or daikon, has been cultivated as a food staple in Japan for many centuries. It is an ingredient in traditional dishes, such as kayu (rice gruel with vegetables or red beans), and snegiri or kiriboshi (radish strips dried for winter storage) (Yamaguchi and Okamoto, 1996).

Farmers continue small-scale garden production and breeding of local landraces for seed production in the

mountainous region of Kyushu (Yamaguchi and Okamoto, 1996). Oilseed radishes with different colored taproots are used for specific purposes and food types. Leaves are edible and sometimes eaten as mustard greens.

Adaptation

Oilseed radish grows best in cool, moist growing conditions (most often during the fall). Plants are not tolerant of shade, standing water, or severely nitrogen-deficient soils (Weil et al., 2006). Oilseed radish plants tolerate soils with pH values of 6.0-7.5 (Midwest Cover Crops Council, 2012). Oilseed radish can be limited by soil nitrogen levels, though the degree of limitation depends on soil texture and history of nutrient application. Often, planting occurs after manure, sludge, or fertilizer application because oilseed radish is highly responsive to nitrogen fertilization (Midwest Cover Crops Council, 2012). Plants cannot survive freezing temperatures of 20°F or below (Sundermeier, 2008).

Establishment

Prepare a clean, firm, weed-free seedbed prior to planting oilseed radish. Planting times should allow at least 60 days of plant growth before winterkill (Sundermeier, 2008). Adjust planting times according to the first expected frosts. Oilseed radish will die or sustain damage if temperatures drop below 20°F (Sundermeier, 2008). In the Mid-Atlantic, planting times are generally late August or early September. Studies in Michigan report that oilseed radish can also be planted in early spring to provide nitrogen to the primary crop planted in May or early June, though growth is limited (Ngouajio and Mutch, 2004).

Adjust seeding rate based on goals. Lower planting rates of 5-6 lb/acre of pure live seed (PLS) produce larger taproots, which may assist with soil compaction. Higher planting rates of 15-20 PLS produce smaller taproots and weaker plants; however, more root surface area may help trap more nematodes or assist with soil-borne pest suppression.

Seeding rates vary. Use the small grain box (seed is similar in size to alfalfa) on a conventional or no-till drill. Typical seeding rates for a pure stand of oilseed radish are 6-10 lb/acre of pure live seed (PLS) (Weil et al., 2006). If establishing a mixed stand of oilseed radish and a legume species, planting rates as low as 1 PLS lb/acre are recommended (Midwest Cover Crops Council 2012). Calibrate drill prior to use to ensure proper seeding rate.

Planting depth should be ¼ to ½ inch (Ngouajio and Mutch, 2004). Drilling yields more successful stands, but seed can also be broadcast at a higher rate of 12-14 PLS lb/acre. Follow broadcast seeding with a light disking, cultipacking, or rolling with water-filled roller.

Aerial/surface seeding can be done on standing crops when the crops reach physiological maturity (Midwest Cover Crops Council, 2012). Increase seeding rates to 14-16 PLS lb/acre and broadcast into standing corn or soybean canopies when lower leaves begin to turn yellow (Weil et al., 2006). Cotton crops can be aerially seeded prior to defoliation and harvest.

Seeding oilseed radish with other cover crops may be beneficial. A mixture of oilseed/forage radish and rye significantly increased soybean yields in Maryland when compared to either species alone (Weil and Williams, 2003). Studies show that the nitrogen trapped by oilseed radish may leach out of the soil after it decomposes if another planted crop does not reabsorb it. Prevent leaching by planting rye or other crops that do not frost kill and can trap nitrogen longer in a mix with oilseed radish. Oilseed radish does not fix nitrogen, and can be seeded with a leguminous species to further improve nitrogen levels.

Management

Oilseed radish establishes quickly if soil moisture is adequate (soil moisture varies by soil texture). Plants will scavenge leftover nitrogen in the soil profile and do not typically need additional fertilization. The most important management consideration when planting oilseed radish is ensuring that plants do not to go to seed. As taproots decompose a foul rotten-egg or natural gas-like odor is emitted.

Pests and Potential Problems

Avoid planting oilseed radish as a cover crop when the cash crop includes broccoli, cabbage, radish, or other members of the mustard family, it can encourage the establishment of pathogens and pests. Brassicas are susceptible to clubroot disease caused by the soil-borne fungus *Plasmodiophora brassicae*, cabbage root maggot (*Delia radicum*), and flea beetle (*Phyllotreta* spp.) (Ngouajio and Mutch, 2004). Harlequin bugs (*Murgantia histrionica*) and flea beetles may attack oilseed radish if it survives the winter (Weil et al., 2006). Flea beetles can host bacteria causing Stewart's wilt of sweet corn (*Erwinia stewartii)* (Midwest Cover Crops Council, 2012). Rotate other cover crop species with oilseed radish to avoid pest and pathogen problems.

Control/Cover Crop Termination

Oilseed radish must be terminated prior to planting of a primary crop to allow primary crop germination. Terminate oilseed radish cover crops at least three weeks before planting the primary crop (Midwest Cover Crops Council, 2012). The nutrient-rich residue then becomes available for use by the primary crop. Oilseed radish will naturally die in winter conditions/frost when temperatures fall below 20°F and decompose naturally in the soil (Sundermeier, 2008). If winter temperatures are mild, oilseed radish may re-sprout from taproots, seed out, and become a weed pest (Snapp and Mutch, 2003).

Adjust planting times to synchronize winterkill with maximum growth of the crop. If plants do not winterkill, they may be terminated and incorporate into the soil by mowing, grazing, lightly disking, or spraying with appropriate herbicide treatment at flowering before seed set.

If the primary goal of the cover crop is to discourage soil pests, the Midwest Cover Crops Council recommends mowing oilseed radish at flowering, tilling into the soil, irrigating (unless natural precipitation is expected), and sealing with a mechanical roller (2012).

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Seeds and Plant Production

Radish seed production occurs in the northwestern US in Idaho, Washington, and Oregon. Locations where summer temperatures exceed 90°F produce poor seed set (Navazio, 2007). Radish is a cross-pollinated species and seed set benefits from pollination; however, wild radish (*Raphanus raphinastrum)* can cross-pollinate with oilseed radish if within one mile of the crop (Novazio, 2007).

Harvest seeds when pods turn from green to yellow/brown. Seedpods do not readily shatter and require mechanical separation using stationary threshers with rollers to remove chaffy material (Navazio, 2007). Large-scale harvest of seed is difficult. Using a combine to harvest seeds requires custom attachments (Steve Groff, personal communication 2012). One pound of seed contains an average of 34,000 seeds (Midwest Cover Crops Council, 2012).

Cultivars, Improved, and Selected Materials (and area of origin)

Seeds are available from select commercial sources, but can be more expensive than many other cover crop species. There are several trademark varieties in the United States, including Tillage Radish®, Nitro™ and Groundhog™. Many cultivars including 'Adagio', 'Arena', 'Colonel', 'Remonta' 'Revena', 'Rimbo', and 'Ultimo' have European origins. Commercially available 'common' varieties are also sold under 'VNS' for variety not stated. Ngouajio and Mutch (2004) found that biomass production was similar in the Adagio, Arena, Rimbo, and common varieties.

Durling and Ackroyd (2010) found that Daikon VNS growth and performance was similar to 'Groundhog', 'Defender', 'Tillage', 'Diakon Midwood' 'Diakon Nema common' and 'Driller' varieties. 'Diakon Midwood,' and 'Nema Common' flowered in both Michigan and Minnesota prior to winterkill, while 'Diakon VNS' flowered in Michigan when planted in early August (Durling and Ackroyd, 2011).

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Citation

Jacobs, Alayna A. 2012. Plant Guide for oilseed radish (*Raphanus sativus* L.*)*. USDA-Natural Resources Conservation Service, Booneville Plant Materials Center. Booneville, AR 72927.

Published May 2012

Edited: may2012 aym, may2012 pac, may2012cs, may2012 plsp

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