Brassica nigra (L.) Koch (Brassicaceae)
Black Mustard

Description. Annuals; stems erect, 40-250 cm tall, branched throughout or above the middle, glabrous to sparsely hirsute at base, the trichomes simple. Lower leaves 10-20 cm long, lowermost in basal rosettes, petioled, blades obovate, deeply pinnatifid to pinnately lobed, with 1-3 pairs of lateral lobes, the terminal lobe much larger than proximal ones; cauline leaves gradually reduced upward, upper ones sessile, ovate to elliptic in outline, the base tapered, uppermost often linear. Inflorescence a raceme; petals 6-10 mm long, yellow; pedicels in fruit 2-6 mm long, straight, erect to somewhat appressed; fruit a silique, 10-20 mm long, squarish in cross-section, each valve with one longitudinal vein, the stylar beak 1-4 mm long, somewhat terete, seedless. Seeds usually in one series per locule, ca. 1-1.5 mm in diameter, globose, wingless, minutely reticulate. (Abrams 1944, Fernald 1950, Barker 1986, Heywood 1964, Jepson 1936, Munz 1959, Rollins 1993, Wagner et al. 1990).

NOTE: Similar species include *Brassica juncea* (L.) Czernov, canola, *B. napus* L., and birdsrape mustard, *B. rapa* L. (Rollins 1993). In contrast to black mustard and *Hirschfeldia*, the former 3 species have ascending to spreading fruits. Relative to black mustard, all 3 species also have stylar beaks that (in fruit) are at least as long as the seed-bearing portion of the silique. Based on recent studies, *Brassica nigra* is more closely related to *Sinapis* and *Hirschfeldia* than it is to other *Brassica* species (Hu and Quiros 1996, Song and Osborn 1992, Song et al. 1991, Warwick and Black 1991).

Black mustard also may be confused with *Hirshfeldia incana* (L.) Lagr-Fossat [*Brassica geniculata* (Desf.) L., *B. incana* Meign.], and *Sinapis kaber* DC. [*Brassica kaber* (DC.) Wheeler, wild mustard]. Both genera differ by having silique valves that are obscurely or faintly 3-5-7-veined. *Hirschfeldia* differs by having a dense, retrorsely hispid pubescence on the stems, conspicuously swollen stem bases, and fruits tightly adpressed (rather than loosely appressed) to the inflorescence axis. *Sinapis* differs by having ascending fruits, and a stylar beak at least as long as the seed-bearing portion of the silique.

Geographic distribution. Black mustard is believed to be native of Eurasia, but its original range is apparently unclear (Heywood 1964). Introduced to Australia, southern Africa, temperate North America (where widespread), including Mexico and Central America, and Hawaii (Arnold and de Wet 1993, Hewson 1982, Rollins 1993, Wagner et al. 1990).

Black mustard was first reported from California “near San Francisco” in 1870 (Bolander 1870), although it probably had become well established much earlier (Jepson 1936, Robbins 1940). Naturalized populations occur on all the Channel Islands (Junak et al. 1997), and at low elevations in most California counties (Wilken 1998).

Ecological Distribution. In its native range, black mustard occurs along roadsides and disturbed areas (Heywood 1964). In naturalized areas it occurs in similar habitats often associated with fallow fields and abandoned pastures (Abrams 1944, Munz 1959, Robbins et al. 1970, Rollins 1993). It also has been reported as invading annual grasslands in recently burned chaparral and coastal sage scrub in southern California (Zedler et al. 1983)

Reproductive and vegetative biology. Black mustard is strongly self-incompatible and obligately outcrossing (Conner and Sterling 1995, Free 1970). Naturalized populations are pollinated by a diversity of small insects, including honey bees and bumble bees (Carreck and Williams 1997, Collins et al. 1997, Conner and Neumeier 1995, Conner and Sterling 1995, Free 1970). In California, seeds are passively dispersed as siliques mature during the summer (Bell and Muller 1973). Because seeds are spherical, some disperse by gravity and accumulate in low lying areas (White and Harper 1970). Seeds may survive for as long as 50 years when buried in soil (Darlington 1951, Darlington and Steinbauer 1961). Seeds of black mustard germinate evenly and in a short period of time during a cool season (White and Harper 1970), or after the first winter rains in California (Bell and Muller 1973), with most germinating within 4-6 weeks.

Bell and Muller (1973) showed that black mustard often forms a dense cover, especially in disturbed grasslands and openings among coastal sage scrub, and that high densities and dominance on some sites are attributable to allelopathy of the decaying stems and leaves. Black mustard also has been implicated as being allelopathic in fescue grasslands in the Pacific northwest (Peters and Luu 1985). In California coastal scrub communities, *Brassica nigra* and *Hirschfeldia* may dominate some sites after fires, because the dry above-ground biomass ignites more easily than native vegetation and because their seeds can survive fire (Zedler et al. 1983).

Weed status. Black mustard is not considered a noxious weed in agricultural or horticultural practice, at least at a global level (not listed by Holm et al. 1977), nor is it considered a noxious weed by the State Dept. of Food and Agriculture (Anonymous 1996). *Brassica nigra* and *Hirschfeldia incana* are common components of disturbed sites and annual grasslands that are frequently burned in southern California (Zedler et al. 1983). However, black mustard, canola, and birdsrape mustard are all considered important weeds by Lorenzi and Jeffery (1987).

Note: Most species of *Brassica* (including *B. nigra*; e.g., Jung 1995, Mizelle 1991) and cultivars derived from them are used for cattle fodder, vegetable (e.g. cabbage, rutabaga, turnips) and oil crops (e.g., rapeseed oil, canola oil) [Simpson and Conner-Ogorzaly 1986]. Wild and weedy strains of several species, including *B. nigra*, have been used recently for cultivar development using conventional hybridization (Song et al. 1993) and gene transfer studies that confer resistance to fungal pathogens (e.g., *Phoma lingam* and *Leptosphaeria maculans*; Sjodin and Glimelius 1989), and incorporate agronomically beneficial genes (e.g., herbicide resistance, Christey et al. 1991; nitrogen fixation, Golz 1988, Sacristan 1988; genes enabling mycorrhizal relationships, Schreiner and Koide 1993a, 1993b). Consequently, there is a large body of literature devoted to cultivation and control of other weeds within mustard crops, development of herbicide- and pest-resistant strains, and other management tools that enhance successful cultivation of mustards rather than control (e.g., Kharbanda and Tewari. 1996). Based on progress in gene transfer technology and concerns regarding genetic contamination of weedy mustards, Adler et al. (1993) evaluated the potential for migration and incorporation of herbicide-resistant genes into cultivated and wild populations of mustards.

Microbial pathogens. Campbell et al. (1987) reported that pepper spot (*Pseudomonas syringae*), a bacterial disease of cultivated mustards, also infected black mustard in California. Other bacterial and viral diseases of mustards in general include *Xanthomonas* (Daniels et al. 1989) and cauliflower mosaic virus (Leisner et al. 1992). Several fungal pathogens have been reported from black mustard and its relatives, including *Alternaria* (Conn et al. 1990), *Phoma* (Sjodin and Glimelius. 1989), *Leptosphaeria* (Sjodin and Glimelius 1989), and *Rhizoctonia* (Chevre et al. 1996, Kataria and Verma 1992).

Natural resistance to *Alternaria* has been reported in black mustard and related species (Chevre et al. 1996, Gerdemann-Knorck et al. 1994, Shivanna and Sawhney 1993), to *Leptosphaeria* (Rouxel et al. 1991), and to *Rhizoctonia* in canola and rape (Yang and Verma 1992). Zhu et al. (1993) used *Phoma*-resistant strains of *Brassica nigra* in gene transfer studies of oil seed crop cultivars.

Insect pathogens. Several insect species have been reported to infest black and related mustards, including aphids (Malik 1988), cabbage stem flea beetles (Koristas et al. 1991), and pollen beetles (Borg and Ekbom 1996). Mithen et al. (1995) showed that wild strains of black mustard in Great Britain possessed specific glucosinolates (mustard oil components) that reduced attack by generalist insect herbivores, but for which cruciferous specialists were resistant.

Decomposition products of specific glucosinolates are believed to be secondary metabolites involved in conferring resistance (Mayton et al. 1996, Merritt 1996). Most *Brassica* species are hosts for cabbage butterflies (*Pieris)*, except black mustard, which apparently may have a deleterious effect on butterfly eggs (Shapiro and Devay 1987). Resistance to flea beetles in strains of canola were reported by Lamb et al. (1993).

Herbicide control. Horowitz et al. (1990) reported some success in using a combination of surfactants and herbicides (metolachlor, oryzalin, oxadiazon, oxyfluorfen) in tablet form for suppressing black mustard seed germination in container-grown horticultural plants. Other herbicides used for the control of mustards include napropamide (Rouchard et al. 1991), sulfonylurea (Tonnemaker et al. 1992), atrazine (Bowmer 1991), and glyphosate (Bing et al 1996). Bing et al. (1996) reported variation for glyphosate resistance in several species of *Brassica*, including black mustard. Cudney and Baameur (1987) and Vargas (1987) evaluated glyphosate, paraquat and oxyfluorfen as controls of several weeds (including black mustard) in fallow crop fields in California. Lorenzi and Jefferey (1987) recommend the use of 2,4-D in early spring (before seed is formed) for control of canola, black mustard, and birdsrape mustard in abandoned fields, but suggest altrnative stretegies for selective control in cultivated fields.

Resistance to sulfonylurea in *B. napus* was reported by Tonnemaker et al. (1992). In *Brassica rapa*, the use of atrazine (Bowmer 1991, Purcell et al. 1990) and napropamide (Rouchard et al. 1991) for control of *Brassica rapa* has resulted in the rapid evolution of resistant strains.

Other control methods. Although Butler and Bissey (1934) suggested that copper sulfate was effective in controlling mustard in crop fields, Hill and Bryan (1937) later showed that the same treatment on certain nutrient poor soils might favor its growth. Carswell et al. (1996) showed that the fungicide, phosphonate, contributed to growth and success of black mustard seedlings under conditions of low soluble phosphate levels, which normally reduces recruitment in cultivated fields. Weston (1996) discussed the potential for using tillage of several common crop weeds, including black mustard (because of its strong allelopathic effect), in suppressing weeds in cultivated fields.

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