KOCHIA

Bassia scoparia (L.) A.J. Scott

Plant Symbol = BASC5

Contributed by: USDA NRCS Kansas Plant Materials Center, Manhattan, Kansas

Figure 1. P. Allen Casey. 2009. USDA-NRCS. Kochia exhibits red colored stems. Found on a disturbed site along a gravel road. Riley County, Kansas

Alternate Names

Kochia scoparia; Bassia sieversiana; Kochia alata; Kochia trichophila; Kochia trichophylla; burningbush; Mexican fireweed; mock cypress; fireweed; mirabel; summer cypress; common kochia; Mexican summer-cypress; railroad weed; belvedere; firebush; poor man's alfalfa; common red sage

Caution: This plant is highly invasive.
Caution: This plant can be toxic.

Uses

Wildlife and Livestock: During early stages of growth, *Bassica scoparia* is palatable and has high forage value for all classes of livestock and can be hayed or grazed (Everitt et al., 1983; Stubbendieck et al., 2003).

Kochia provides cover and the seeds are used as food by both songbirds and upland game birds (Stubbendieck et al., 2003). The large quantity of high protein seed makes kochia valuable for poultry feed (Friesen et al., 2009). Kochia is also eaten by deer and pronghorn (Stubbendieck et al., 2003).

Erosion Control and Bioremediation: Kochia can be used for control of soil erosion. Undersander et al. (1990) indicated that it is able to survive in a variety of harsh soil conditions, including sandy and alkaline soils. *Bassica scoparia* is drought, salinity, and grasshopper tolerant and is able to grow in areas with very thin topsoil (Friesen et al., 2009). It is especially suited to arid to semi-arid regions (Friesen et al., 2009). It has the ability to germinate and grow at any time during the growing season and will provide quick groundcover to protect the topsoil.

Kochia has been shown to bioaccumulate cesium-137 (Lasat et al., 1997) and may be able to be used for remediation of hydrocarbon contaminated soil (Robson et al., 2004).

Ethnobotanic: Bassica scoparia has been used in Chinese and Korean folk medicine as treatment for skin diseases, diabetes, mellitus, rheumatoid arthritis, liver disorders, and jaundice (Kim et al., 2005; Choi et al., 2002). In Japan and China the fresh fruit is used as a food garnish on some dishes (Yoshikawa et al., 1997) and the seeds are ground into flour (Usher, 1974). In China, Russia, Bulgaria, Macedonia, Romania, and Italy kochia is planted for making brooms (Zimdahal, 1989; Shu, 2003; Nedelcheva et al., 2007; Friesen et al., 2009).

Kochia seeds contain an oviposition pheromone that can be added as an attractant for mosquito pesticides (Friesen et al., 2009; Whitney et al., 2004). The seeds of kochia have also been shown to contain other chemicals that could have beneficial human uses, such as compounds that could be used to treat ulcers, rheumatoid arthritis, and some human pathogenic bacteria (Friesen et al., 2009; Goyal and Gupta, 1988; Borrelli and Izzo, 2000).

Bassica scoparia is grown as an ornamental due to its dense and conical shape as well as its bright red color in the fall (Undersander et al., 1990).

Status

This plant is or can be noxious and/or invasive in some areas. 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
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 plants.usda.gov. Please consult the Related Web Sites on the Plant Profile for this species for further information.

When kochia matures it breaks off at the base of the plant and becomes a tumbleweed which helps disperse the seed. Forcella (1985) concluded that due to this tumbleweed mode of dispersal, kochia had the highest rate of spread among alien weed species in the western United States from 1880 and 1980.

Description
General: Goosefoot Family (Chenopodiaceae). Kochia is an introduced, erect, annual forb with a taproot that forms pyramidal or rounded bushes up to 7 feet (2.1 m) tall. Phillips and Launchbaugh (1958) reported that the roots of *Bassica scoparia* can reach a depth of at least 8 feet (2.4 m) and have a horizontal radius of at least 8 feet (2.4 m) which would allow the plant to draw water from a cylindrical soil mass 16 feet (4.9 m) in diameter and 8 feet (2.4 m) or more deep.

The leaves have alternate arrangement and are simple, linear to narrowly ovate to 5.5 cm long and can have hairs, depending on age. Leaves are very short petioled or sessile. The leaves have 1-5 prominent veins with entire margins fringed with hairs. Stem is green, red tinged, or red depending on age (Friesen et al., 2009). The flowers are green leaf-like bracts and surrounded by tufts of hair (Stubbendieck et al., 2003). The inflorescence is a spike and is axillary and terminal. Flowers are either perfect with 3-5 stamens or pistillate with both types having two stigmas (Friesen et al., 2009). Kochia has utricle fruits with an oval, brown to black seed (Stubbendieck et al., 2003). Kochia varies widely in morphological characters partially due the environment where it is found (Friesen et al., 2009).

Distribution:
Kochia is common throughout the western and northern United States (Friesen et al., 2009). It is also found throughout much of Canada, especially in the arid and semi-arid grasslands (Friesen et al., 2009). Kochia is also found throughout Europe, Africa, and South America, as well as parts of, Asia (Friesen et al., 2009). Although once present in Australia it has now been eradicated (Natural Resource Management Ministerial Council, 2006).

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

Habitat:
Kochia is common in rangelands, pastures, fields, disturbed sites, gardens, roadsides, and ditchbanks (Stubbendieck et al., 2003; Whitson et al., 1991). It can be found in areas with as little as 6 inches (15.24 cm) of annual rainfall (Undersander et al., 1990).

Adaptation
Kochia is native to central and eastern Europe and Asia (Whitson et al., 1991) and was likely introduced as an ornamental in the mid- to late 1800's (Friesen et al., 2009). *Bassica scoparia* can be found in a very wide range of temperatures and climatic regions throughout the world, but is particularly adapted to arid and semi-arid regions, such as the Canadian prairies and the Great Plains region of the United States (Friesen et al., 2009). Kochia exhibits early germination that makes it capable of utilizing limited spring soil moisture in arid to semi-arid regions (Eberlein and Fore, 1984). Germination of seeds can occur multiple times throughout the growing season (Friesen et al., 2009), enabling it to take advantage of moisture when it is available. Seeds are able to germinate under high stress conditions, such as lack of moisture, high salinity, or extremes in pH (Friesen et al., 2009).

Kochia is a facultative alkali halophyte and is tolerant of thin or high salinity soils or acidic soils due to the presence of aluminum or manganese (Friesen et al., 2009; Bilski and Foy, 1988).

Establishment
Undersander et al. (1990) gives the following guidelines for seeding and establishment of Kochia. Soil should plowed or disked and weed free. Planting should be done late April to early May. Liming of the soil to a pH of 6.0 is recommended. Nitrogen equaling 100 – 250 lb N/acre (113 – 282.5 kg N/ha) should be applied by applying 50 – 100 lb/acre (56.5 - 113 kg/ha) before planting and topdressing the remainder later depending on the anticipated yield. Splitting the application and not applying more than 150 lb N/acre (169.5 kg N/ha) at one time reduces the possibility of nitrate toxicity. Suggested potash (K_2O) rates are 24 – 50 lb K_2O/ton (12 – 25 kg K_2O /metric ton) of hay harvested. Drilling seed at 1 lb/acre (1.1 kg/ha) in 36 in (91.4 cm) rows should result in an adequate stand. Seeding rates of 1-4 lb/acre (1.1 to 4.4 kg/ha) may be necessary if a thicker stand is desired or if broadcast seeding is used. Seed depth should not exceed ¾ in (1.9 cm) deep with the best results around ¼ in (0.64 cm). Kochia will need to be thinned to prevent it from crowding itself out. This can be done by thinning to 2-10 plants/ft of row by chiseling at right angles or windrowing portions of the field and allowing livestock to graze the dry feed as they graze the green material. An alternate method of thinning is to allow livestock grazing for a short time when the plants are approximately 2 in. (5.08 cm) tall.

Management

Bassica scoparia is palatable to all classes of livestock. The nutritional value, when immature, is similar to that of alfalfa (Stubbendieck et al., 2003). *Bassica scoparia* can be toxic to livestock and may cause death if consumed in large quantities by cattle, sheep, or horses (Sprowls, 1981). Kochia has been known to cause polioencephalomalacia and photosensitization in range cattle (Dickie and Berryman, 1979). Kochia has been identified as containing saponins, alkaloids, oxalates, and nitrates all of which are toxic substances that seem to be more toxic during times of drought and during seed maturity (Dickie and James, 1983), so caution should be used when using kochia as forage for livestock. It is recommended that kochia forage should consist of not more than 50% of livestock ration (Mir et al., 1991; Saskatchewan Agriculture, 1986). Kochia stands can be grazed by livestock directly but care should be taken to prevent poisoning. Rotational grazing of other crops and not grazing for more than 90-120 days should help prevent poisoning (Undersander et al., 1990). Feeding supplemental phosphorus is recommended for livestock grazing on kochia due to the low amount that is present in the plant (Undersander et al., 1990).

If kochia is cut for hay or silage it should be cut before it has produced seed when it is between 18 – 26 in (45.7 – 66 cm) tall (Undersander et al., 1990). Under irrigated and fertilized conditions kochia could be cut up to four times a year (Foster, 1980). Reports of hay production has varied from 1 ton/acre (2.25 t/ha) (Hanson 1988) to 11.5 ton/acre (26 t/ha) (Foster, 1980) depending on region, moisture, and fertilization.

If it is cut for hay, it will likely need to be crimped and crushed after cutting and is going to take between 10-30 days to cure (Hanson, 1988). Kochia is more resistant to spoiling, even with rain, and can be baled at higher moisture levels than with other crops (Hanson, 1988). If hay is harvested when it is too mature and contains coarse stalks, then bales will need to be processed (i.e. ground) and mixed with other forages for livestock to readily consume it (Hanson, 1988).

Pests and Potential Problems

There are some insects that are found to use kochia as a food source or host, however, they rarely cause major problems to the plants (Friesen et al., 2009). Kochia may be host to various fungi some of which can be detrimental to crops. One such fungus is *Aphanomyces cochlioides* Drechsler, which causes blackroot of sugarbeet in Canada (Williams and Asher, 1996). Friesen et al. (2009) indicated that kochia may be a host for insects that may be vectors for or direct hosts for certain bacteria and viruses that can be problems for some agricultural crops such as potatoes and tobacco.

Figure 2. P. Allen Casey. 2009. USDA-NRCS. Dry kochia in a wheat stubble field. This plant may break off at the base creating a tumbleweed that has the potential to spread seed great distances from where it originated. Riley County, Kansas

Grasses will out-compete kochia (Undersander et al., 1990). This can be a good trait if kochia is used for soil stabilization and it is desired that perennial grasses eventually dominate the site. However, if the goal is to produce kochia as forage rations for livestock, this can be problematic. Currently there is not any herbicide that is registered for weed control in kochia.

Volunteer kochia is likely to be a problem in crops that are planted following kochia and control will be necessary (Undersander et al., 1990). It has been shown that there is at least some herbicide resistance in some populations in parts of the United States, Canada, and the Czech Republic (Friesen et al., 2009). Theses populations have been shown to have at least some resistance to one or more of the following: 2, 4-D, triazine, auxinic herbicides, dicamba, and sufonylurea (Friesen et al., 2009). Kochia seems to be most susceptible to herbicides early in growth, with the effectiveness lessening as the plant matures (Friesen et al., 2009; Eberlein and Fore, 1984).

Environmental Concerns

Kochia is highly invasive and is able to establish and persist in harsh environments were other plants are limited. *Kochia scoparia* has been shown to be one of the most widespread annual weeds in Kansas, Nebraska, Southern Canadian prairies, and throughout the Great Plains Region (Phillips and Launchbaugh, 1958; Blackshaw, 1990; Stubbendieck et al., 2003). Due to the tumble weed type spread of seeds and the documented herbicide resistance, kochia may be hard to control once it is established in an area.

Kochia can become a serious problem in agricultural crops, such as sugarbeets, potatoes, alfalfa, and wheat (Boerboom, 1993). Friesen et al. (2009) indicated that kochia has some allelopathic properties which inhibit growth of other kochia plants and other plant species, including common agricultural crops.

Control

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.

Kochia exhibits leaf characteristics, such as pubescence and a wax, which makes absorption of herbicides difficult (Harbour et al., 2003). Absorption and efficacy of herbicides is greatly dependent on the dose applied and the maturity of kochia, with herbicides becoming less effective as the plant matures.

Some populations have shown resistance to 2, 4-D, triazine, auxinic herbicides, dicamba, and sufonylurea (Friesen et al., 2009). The herbicide 2, 4-D, itself, does not provide acceptable control regardless of formulation, dose, or the timing of the application (Friesen et al., 2009).

Seeds and Plant Production

Germination is possible when the top 1-1.5 inches of the soil become frost free and the soil temperature reaches 50°F (10°C) (Becker, 1978; Undersander et al., 1990). Viability of kochia seed is greatly reduced 1-2 years after production, with germination rates shown to be only 5% after one year and 1% after three years, thus preventing persistent seed banks of kochia seed (Friesen et al., 2009).

Seed production is highly variable and depends on the conditions and the competition that the plant endures (Friesen et al., 2009). Stallings et al. (1995) observed that field grown kochia can produce anywhere from 2,000 to 30,000 seeds per plant. Mature seed is not dormant and can germinate immediately under suitable conditions (Friesen et al., 2009). Seed can be harvested using a combine (Undersander et al., 1990). Kochia reproduces solely from seed and has no means or structures for vegetative reproduction (Friesen et al., 2009).

Seedlings of kochia can tolerate frost (Eberlein and Fore, 1984), but mature plants may not be able to produce viable seed in regions with a short frost free growing season (Friesen et al., 2009).

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

These plant materials are somewhat available from commercial sources as an ornamental. These plant materials are not readily available from commercial sources for use as livestock forage.

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