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Strategic Use of Forage Kochia (*Kochia prostrata*) to Revegetate Wildlife Habitat

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ABSTRACT

Forage kochia (*Kochia prostrata* [L.] Schrad.) is a long-lived, perennial, half-shrub adapted to the temperate, semiarid regions of central Asia and the western U.S. In these areas it is a valuable fall/winter forage plant for sheep, goats, camels, cattle, horses, and wildlife. *Forage kochia* is extremely drought, heat, and salt tolerant. *Forage kochia* plants are very competitive with the annual noxious weeds cheatgrass (*Bromus tectorum* L.) and halogeton (*Halogeton glomeratus* [Stephen ex Bieb.] C.A. Mey.) and it is one of few species that can be successfully established on severely degraded, frequently burned, cheatgrass-infested rangelands. *Forage kochia* also is being used to establish 'greenstrips' to stop the spread of wildfires, due to its high moisture content and ability to reduce the frequency of highly flammable cheatgrass. *K. prostrata* and *K. scoparia* are both sometimes referred to as 'forage kochia' and 'summer cypress'; however, *K. prostrata* differs in that it has a perennial growth habit, does not spread into perennial plant stands, is not known to contain toxic levels of nitrates or oxalates, and increases biodiversity on rangelands. The cultivar 'Immigrant' was released in 1984 and remains the only released cultivar of *forage kochia* in the U.S., and is a short-statured, diploid type, used for livestock and wildlife forage, rangeland reclamation, and suppression of wildfires. An active breeding program is underway to develop larger statured, more productive *forage kochia* cultivars to enhance its utilization as winter forage and habitat in the temperate deserts of the western U.S. Overall, *forage kochia* is not likely to become a noxious weed, but does have the potential to improve the sustainability of rangelands and wildlife habitat in semiarid regions that frequently experience extended drought, salinity, and wildfires.

In Monaco, T.A. et al. comps. 2011. *Proceedings – Threats to Shrubland Ecosystem Integrity*; 2010 May 18-20; Logan, UT. *Natural Resources and Environmental Issues*, Volume XVII. S.J. and Jessie E. Quinney Natural Resources Research Library, Logan Utah, USA.

INTRODUCTION

Forage kochia (*Kochia prostrata* [L.] Schrad.) (synonym=*Bassia prostrata* [L.] A.J. Scott), sometimes called prostrate kochia, or prostrate summer cypress is a long-lived, perennial, semi-evergreen, half-shrub adapted to semiarid, arid, alkaline, and saline rangelands and steppes (Harrison et al. 2000; Gintzburger et al. 2003). *Forage kochia*'s native distribution ranges from central Europe to the west, Siberia in the north, Afghanistan and Asia Minor in the south, and east to China, Mongolia, and Tibet (Balyan 1972). *Forage kochia* was introduced to North America in the early 1960s where it has proven to be well adapted to the temperate, semiarid rangelands of the western U.S. (Harrison et al. 2000). *Forage kochia* has a perennial woody base with yearly herbaceous growth that can reach heights ranging from 30 to 75 cm, and a thick woody root system that reaches depths of 3 to 6.5 m (Gintzburger et al. 2003).

Forage kochia is a distant relative of annual kochia (*K. scoparia* L.) and gray molly (*K. Americana* S. Wats), with recent research showing that these three species of *Kochia* are genomically distinct and do not cross hybridize (Lee et al. 2005). *K. prostrata* and *K. scoparia* are both sometimes referred to as 'forage kochia' and 'summer cypress'; however, *K. prostrata* differs in that it has a perennial growth habit, does not spread into perennial plant stands, and is not known to contain toxic levels of nitrates or oxalates (Harrison et al. 2000). *Forage kochia* (*K. prostrata*) is a complex species within the *Chenopodiaceae* family represented by multiple ploidy levels and subspecies (Balyan 1972; Gintzburger et al. 2003; Waldron et al. 2005).

Because of its competitive nature, some people have worried about *forage kochia* invading and suppressing native plant populations in the U.S. (Clements et al. 1997; Harrison et al. 2000). However, several researchers have reported that Immigrant *forage kochia* competes well with annuals, but does not invade perennial plant communities (Pendleton et al. 1992; Harrison et al. 2000; Monaco et al. 2003).

Competition With Annual Grasses and Stopping Wildfire

It has been shown that forage kochia is broadly adapted to various semiarid rangelands (McArthur et al. 1996; Harrison et al. 2000), has high salt and alkali tolerance (Francois 1976), and is competitive against the annual noxious weeds cheatgrass (*Bromus tectorum* L.) and halogeton (*Halogeton glomeratus* [Stephen ex Bieb.] C.A. Mey.) (Stevens and McArthur 1990; Monaco et al. 2003). Newhall et al. (2004) reported that forage kochia was one of few species capable of establishing and competing with cheatgrass (*Bromus tectorum* L.) in a salt desert shrub environments frequently experiencing wildfires, severe wind erosion of topsoil, and drought. Monaco et al. (2003) conducted research in a similar environment that historically had been used for winter grazing of sheep, but where overgrazing and repeated wildfires had completely eliminated all perennial shrubs leaving only a monoculture of cheatgrass. They reported that forage kochia established, persisted, and reduced the biomass and frequency of cheatgrass during a 10 year period with annual precipitation ranging from 127 to 200 mm. Harrison et al. (2002) reviewed the characteristics that make forage kochia a good plant material for greenstrips to stop wildfires in semiarid regions. The study sites in the Newhall et al. (2004) and Monaco et al. (2003) papers have both successfully stopped wildfires since their establishment.

Nutritional and Grazing Value

The literature suggests that forage kochia is most abundant in the countries of Kazakhstan, Uzbekistan, and Kirghistan, where it is recognized as an important fall and winter forage for sheep, cattle, horses, camels, and wildlife (Balyan 1972; Waldron et al. 2001; Gintzburger et al. 2003; Waldron et al. 2005). Waldron et al. (2010a) reviewed forage kochia's nutritional attributes. In summary, forage kochia has high crude protein (CP) (> 70 g/kg) during the critical fall/winter grazing period (Davis 1979; Davis and Welch 1985; Waldron et al. 2006), low non-toxic levels of oxalates (Davis 1979), acceptable digestibility (Welch and Davis 1984; Davis and Welch 1985; Waldron et al. 2006), increased rate of fiber digestion (Waldron et al. 2010a), and high palatability to livestock (Waldron 2010b). Waldron et al. (2006)

recently documented that forage kochia maintained or improved body condition of cattle during the winter without any additional protein or nutrient supplementation and resulted in a 25 percent economic savings over alfalfa hay feeding practices.

Forage kochia's forage yield potential varies depending upon the subspecies and environment, but generally ranges from 1000 to 6000 kg/ha (Balyan 1972; Nechaeva 1985; Gintzburger et al. 2003; Waldron et al. 2006; Waldron et al. 2010a) and in almost all cases, the reported yields represent a 3 to 6 fold increase in forage production as compared to existing rangeland without forage kochia. In the western U.S., forage kochia is being used to provide critical forage and habitat for wildlife, including deer, antelope, wild horses, and birds. This value is most pronounced in areas where wildfires have destroyed native vegetation.

Collection and Breeding

Breeding of improved cultivars appears to have begun in the 1970s in the former U.S.S.R. resulting in several improved cultivars of forage kochia (Alimov and Amirkhanov 1980; Herbel et al. 1981; Nechaeva 1985; Rabbimov 1984); however, these are not commercially available at this time. Krylova (1988) and Harrison et al. (2000) independently reviewed the introduction, cultivar development, and cultivation of forage kochia in the U.S. In brief, forage kochia was introduced to the U.S. in 1966 by researchers looking for a plant to suppress halogeton on droughty and saline soils (Harrison et al. 2000). One germplasm accession was selected and released as the cultivar 'Immigrant' in 1984 based upon its overall persistence, forage production, forage quality, palatability, and competitiveness with annual weeds (Stevens et al. 1985). Immigrant remains the only released cultivar of forage kochia in the U.S., and is a short-statured, diploid, subspecies *virescens* type used for livestock and wildlife forage, soil stabilization, rangeland reclamation, and suppression of wildfires.

The USDA-ARS Forage and Range Research Laboratory in Logan, Utah currently has an active forage kochia research and breeding program. This program researches the use and establishment of forage kochia, and develops larger statured, more productive, easier establishing cultivars with a goal to

enhance its utilization as winter forage in temperate, desert regions. Scientists from this lab have led collection trips to Kazakhstan (Waldron et al. 2001) and Uzbekistan (Waldron et al. 2005) collecting over 250 accessions of forage kochia. Improved, taller statured breeding lines are being evaluated throughout the western U.S. and in the country Jordan (Bailey et al. 2010).

CONCLUSION

Kochia prostrata is a valuable forage plant for livestock and wildlife in the temperate, semiarid and arid regions of central Asia. In these areas, it is known as the “alfalfa of the desert” (Waldron et al. 2005). It is not as common in the semiarid western U.S., but it is often recommended for reclaiming degraded rangelands, in part because of its competitive advantage over cheatgrass, as well as its value as forage and habitat for livestock and wildlife. It is extremely drought and salt tolerant, often growing in extremely harsh environmental conditions that preclude the successful establishment of other plant species. Research and experience have shown that forage kochia is a very palatable and nutritious shrub, especially during the fall and winter when nutritional quality of other plants is low. Its nutritional characteristics include CP levels above the 70 g/kg needed for ruminant animals, acceptable fiber levels, and low tannins and oxalates. Because of its competitive ability, some are concerned about forage kochia becoming an invasive weedy species. However, research and long-term observations indicate that forage kochia competes well with annuals, but does not readily invade perennial plant communities. Forage kochia has the potential to improve the habitat and sustainability of wildlife populations in areas that are threatened with frequent wildfires, extended drought, and increasing salinity.

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