Re-establishing Perennial Vegetation in Cheatgrass Monocultures

Planting prostrate kochia in 'greenstrips' may be a viable option to decrease cheatgrass dominance.

By Thomas A. Monaco*, Blair L. Waldron, Robert L. Newhall, and W. Howard Horton

Humans have had a significant impact on shrublands of the western United States. The introduction of large numbers of livestock into native plant communities that had evolved without grazing pressure has greatly altered vegetation composition. Overgrazing resulted in the loss of perennial grasses and facilitated the widespread invasion by annual species such as cheatgrass (*Bromus tectorum*).

With a herbaceous understory dominated by the short-lived, highly flammable cheatgrass, shrublands became prone to frequent wildfires. Cheatgrass persists under this fire regime because it germinates, grows, flowers, and sets seed before environmental conditions become conducive to wildfires. However, frequent wildfires greatly hinder natural regeneration of long-lived shrubs and complicate efforts to repair the structure and function of western shrublands.

Although this scenario of shrubland conversion to annual grasses has been the focus of scientific research efforts for many decades, few land-management options exist that are capable of re-establishing perennial vegetation in fire-prone regions of the Great Basin and Intermountain West.

Establishment of perennial vegetation in cheatgrass-dominated landscapes is difficult because the rapid growth rate of cheatgrass, especially under cool temperature, makes it extremely competitive for limited soil water and nutrients compared to slower growing perennial species. Even if management efforts successfully revegetate small areas, persistent seedbanks of cheatgrass and a high probability of wildfire undermine the persistence of perennial species. Consequently, to break cheatgrass dominance, wildfire frequency must first be reduced before persistent, perennial vegetation will successfully establish and begin the process of stabilizing landscapes.

Planting fuel-breaks or 'greenstrips' of less flammable perennial vegetation (e.g., Monsen 1994) in strategic locations may provide a feasible option to reduce wildfire frequency (Pellant 1994). Greenstrips are an attractive option because a relatively small area is managed to protect a much larger area. Greenstrips will be most successful if the perennial vegetation can rapidly establish in cheatgrass-dominated areas, tolerate occasional wildfires, and be capable of reducing fine-fuel loads so that additional perennial vegetation can be incorporated back into the landscape.

Species common to salt desert shrublands.

Common Name	Scientific name
shadscale	*Atriplex confertifolia*
greasewood	*Sarcobatus vermiculatus*
winterfat	*Krascheninnikovia lanata*
four-wing saltbush	*Atriplex canescens*
bottlebrush squirreltail	*Elymus elymoides*

Case Study: Skull Valley, Utah

In the 1950s, vegetation in the basins of Skull Valley was dominated by shadscale, greasewood, winterfat, four-wing saltbush, and bottlebrush squirreltail. However, by the mid-1970s, repeated wildfires (natural and human caused) and cheatgrass invasion initiated the elimination of many perennial species in Skull Valley. Recent statistics indicate that over 90% of the individual wildfires in Skull Valley burn greater than 5,000 acres, which leaves little opportunity for perennial vegetation to establish or persist.

Consequently, Skull Valley is an ideal area to evaluate the possibility of establishing persistent, perennial vegetation in narrow greenstrips that may lead to reduced cheatgrass dominance.

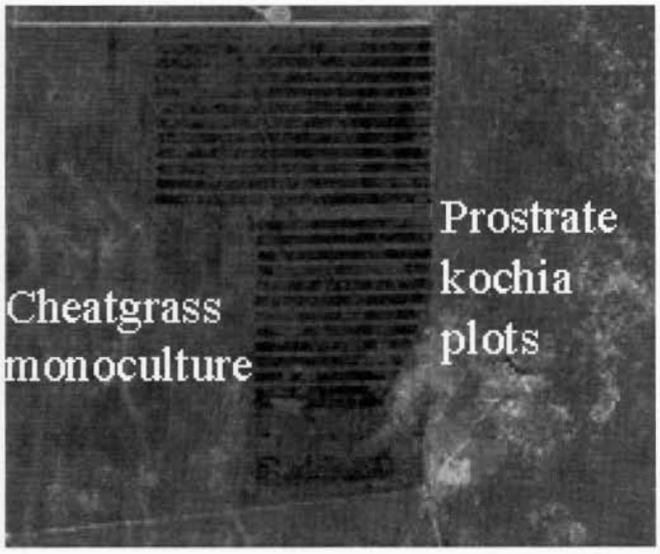

Figure 1. *Aerial photograph of Whiterocks Road research area showing prostrate kochia plots established in cheatgrass monoculture in Skull Valley, Utah.*

In 1991, greenstrips were established in cheatgrass monocultures at the White Rocks Road Research Area in Skull Valley using the perennial shrub prostrate kochia (Chenopodiaceae) (Page et al. 1994). Prostrate kochia is a half-shrub (i.e., suffruticose) native to arid and semiarid regions of central Eurasia and is well adapted to soils and climate of sagebrush and salt desert plant communities of the western U.S. (Stevens et al. 1985). The variety 'Immigrant' was released in the U.S. in 1984 and has been subsequently used to stabilize over 150,000 acres of arid rangelands in the western U.S.

Prostrate kochia was seeded in 50 x 1,320-foot or 50 x 800-foot linear plots using 4 methods (Tye no-till drill , broadcast, harrow-broadcast, and broadcast-harrow), at 3 seeding rates (1, 3, and 6 lbs pure live seed per acre), and in 3 seasons (fall, winter, and spring). Each plot was separated by at least a 25-foot area where cheatgrass remained as a monoculture.

Percent cover of prostrate kochia and cheatgrass were evaluated in 1993 and 2001 in all 36 combinations of seeding method, rate, and season, by placing standard Daubenmire frames (50 x 20 cm) at 20 locations along four linear transects (20 m) that ran perpendicular to plots. An aerial photograph of the 36 plots was taken in 1998 (USGS) and is shown in Figure 1.

In addition, biomass of cheatgrass was measured in June 2001 and 2002 to quantify flammable, fine-fuel loads produced by cheatgrass for 6 of the plots that had similar prostrate kochia density. These harvests were made along 5 linear transects running perpendicular to the plots. Along these transects, square wire frames (0.25 x 0.25 m) were placed at 2 locations within the middle of plots, on the plot-cheatgrass monoculture north and south boundary, and in 2 locations within the middle of the cheatgrass monoculture (north and south of each plot). Vegetation within the frames was clipped at the ground surface, collected, and then dried to obtain biomass.

Perennial Vegetation Persists After 10 Years

Prostrate kochia established successfully in cheatgrass monocultures regardless of seeding method, rate, or season (Figure 2). Even when establishment was initially low in Spring 1993, by 2001 prostrate kochia canopy cover was comparable to the fall and winter seedings.

Initial differences in seeding rate and seeding method observed in 1993 also diminished by 2001,

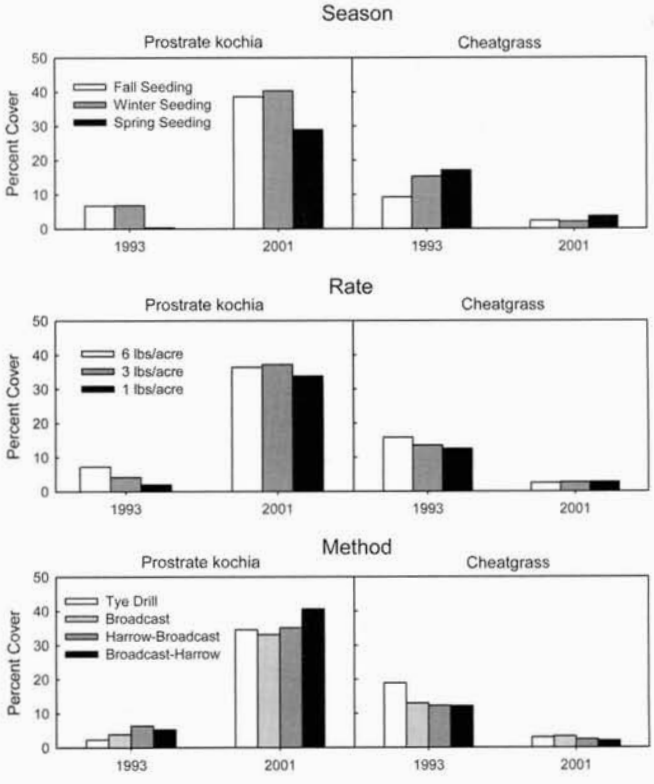

Figure 2. *Percent cover of prostrate kochia and cheatgrass in 1993 and 2001.*

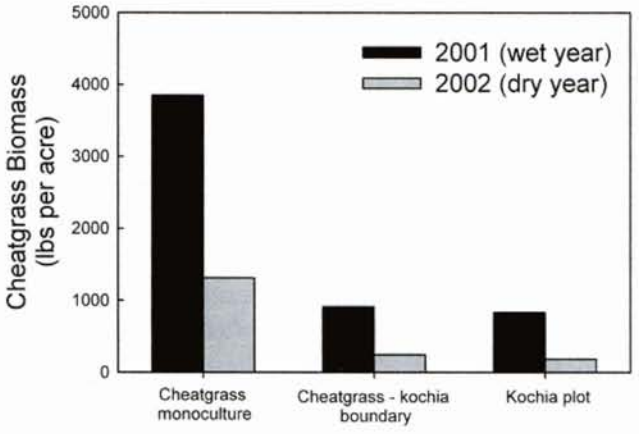

Figure 3. *Cheatgrass biomass in 2001 and 2002 at White Rocks Road research area.*

Figure 4. *Prostrate kochia plots and cheatgrass monoculture at White Rocks Road research area in Skull Valley, Utah.*

suggesting that prostrate kochia density stabilizes at between 30 and 40% canopy cover for this arid salt-desert site (5 to 8 inches average annual precipitation).

Cheatgrass cover greatly decreased within plots between 1993 and 2001. These results are encouraging because they demonstrate the ability of prostrate kochia to persist 10 years after planting, while greatly reducing cheatgrass cover.

Reduced cheatgrass canopy cover within our plots translate into less cheatgrass fine-fuel loads and a reduced capacity to sustain wildfires (Harrison et al. 2002). Cheatgrass monocultures had 4 times the amount of cheatgrass biomass compared to the plots in both wet (2001) and dry (2002) years (Figure 3). Cheatgrass biomass at the cheatgrass-plot boundary was similar to values within the plots, indicating that cheatgrass does not recruit into established prostrate kochia stands at this site. One of the most striking observations is how prostrate kochia maintained these sharp boundaries with cheatgrass (Figure 4). Even after 10 years, prostrate kochia vegetation had not moved beyond where it was seeded, as has been documented for other large-scale plantings in arid regions (Harrison et al. 2000).

Future Considerations

Although the results of this evaluation demonstrate the merit of prostrate kochia to effectively establish, persist, and reduce cheatgrass dominance, we recognize that there may be both positive and negative ecological consequences of deliberate plant introductions (e.g., Ewel et al. 1999).

A positive aspect of using this introduced shrub in greenstrips is that it rapidly establishes following disturbance, thus minimizing soil loss. A negative aspect of using this introduced shrub in greenstrips is that little is known about its compatibility with desirable native species.

Efforts to restore former shrublands now dominated by cheatgrass require re-establishing plant structure and composition and key ecosystem processes for long-term stability (e.g., McIver and Starr 2001). Frequent wildfires preclude the natural processes of regeneration and the long-term stability of shrublands of the Great Basin. The potential for progress will remain low for rehabilitating cheatgrass-dominated, fire-prone landscapes if wildfire frequency is not first reduced.

Because prostrate kochia competes well with cheatgrass and persists for many years, it appears to be one of the best candidates for inclusion in greenstrips to break up the continuity of cheatgrass fine-fuel loads.

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References

Ewel, J.J., D.J. O'Dowd, J. Bergelson, C.C. Daehler, C.M. D'Antonio, L.D. Gomez, D.R. Gordon, R.J. Hobbs, A. Holt, K.R. Hooper, C.E. Hughes, M. LaHart, R.R.B. Leakey, W.G. Lee, L.L. Loope, D.H. Lorence, S.M. Louda, A.E. Lugo, P.B. McEvoy, D.M. Richardson, and P.M. Vitousek. 1999. Deliberate introductions of species: Research needs. Bioscience. 49:619-630.

Harrison, R.D., N.J. Chatterton, B.L. Waldron, B.W. Davenport, A.J. Palazzo, W.H. Horton, and K.H. Asay. 2000. Forage Kochia – Its compatability and potential aggressiveness on Intermountain rangelands. Utah. Ag. Exp. Sta. Res. Rep. 162. Utah State Univ., Logan, Ut. 84322-4800. 66 p.

Harrison, R.D., B.L. Waldron, K.B. Jensen, R. Page, T.A. Monaco, W.H. Horton, and A.J. Palazzo. 2002. Forage kochia stops range fires. Rangelands 24:3–7.

McIver, J. and L. Starr. 2001. Restoration of degraded lands in the interior Columbia River basin: passive vs. active approaches. For. Ecol. Manage. 153:15–28.

Monsen, S. B. 1994. Selection of plants for fire suppression on semiarid sites. p. 363–373. *In:* S.B. Monsen and S.G. Kitchen (compilers). Proceedings-symposium on ecology and management of annual rangelands. 18–21 May 1992. Boise, ID. Gen. Tech. Rep. INT-GTR-313. USDA Forest Service, Intermountain Research Station, Ogden, Ut. 416 p.

Page, R.J., P. Rasmussen, H.H. Horton, R.L. Newhall, D.E. Wilson, G.W. Kidd, and T.C. Roberts, Jr. 1994. White Rocks Road Immigrant forage kochia trial seedings. Rangelands 16:167-168.

Pellant, M. 1994. History and applications of the Intermountain greenstripping program. p. 63–68. *In:* S.B. Monsen and S.G. Kitchen (compilers). Proceedings-symposium on ecology and management of annual rangelands. 18–21 May 1992. Boise, Id. Gen. Tech. Rep. INT-GTR-313. USDA Forest Service, Intermountain Research Station, Ogden, UT. 416 p.

Stevens, R., K.R. Jorgensen, E.D. McArthur, and J.N Davis. 1985. 'Immigrant' forage kochia. Rangelands 7:22-23.