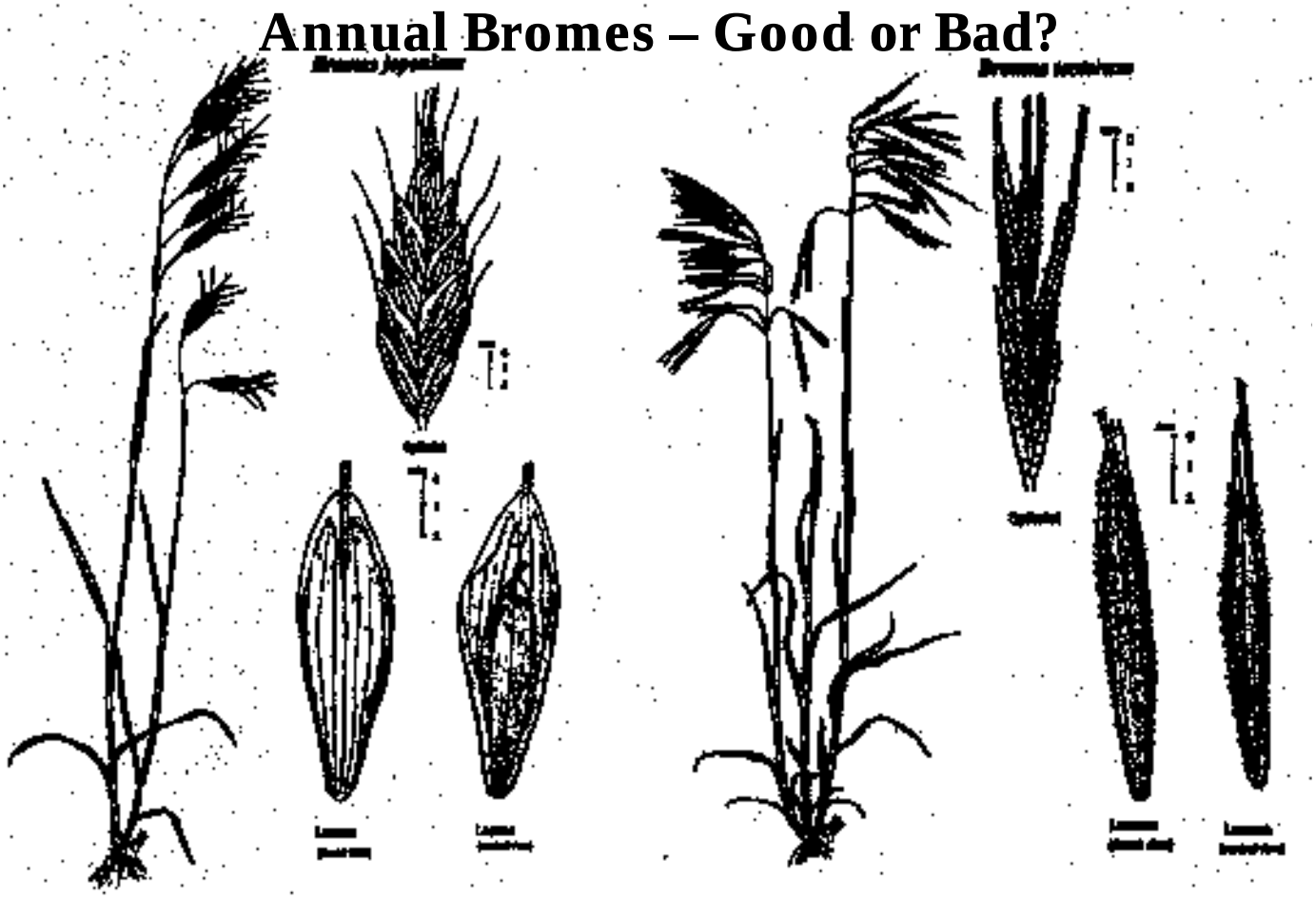
Annual Bromes – Good or Bad?



A question and answer on the impact annual bromes have on rangelands.

By Marshall R. Haferkamp

Are annual bromes good or bad? Japanese brome (*Bromus japonicus* Thunb) and downy brome (*B. tecto - rum* L.)—weedy cool-season annual grasses – have invaded thousands of acres of the Northern Great Plains, Great Basin, California Annual Grasslands, and Palouse Prairie. What is the impact of annual bromes on infested range lands? During my range research career, I've had several personal experiences with annual bromes.

Colorado and South Dakota: My first encounter with annual bromes was in the mid 1960s while attending Colorado State University in Fort Collins. At that time I did not realize that working with annual bromes would become such a large part of my future research career. As a student, I saw downy brome on a daily basis during laboratory assignments and on part-time jobs. I encountered Japanese brome in South Dakota while working with professor Tex Lewis. By 1968, Japanese brome covered relatively large areas in the exclosures and lightly grazed pastures at the Cottonwood Experimental range in western South Dakota.

Oregon: I began research work with annual bromes in 1981 when I moved to Burns, Oregon. Downy brome was one of the major species we had to control before establishing successful range seedings in the Northern Great Basin and Palouse Prairie. Annual bromes have invaded vast acreages in the Great Basin and Palouse Prairie. These acreages are maintained in part by the cyclic fire regime of the regions. Establishing autumn seedings of cool-season grasses was enhanced by reducing competition from annual bromes. We generally were successful when we prepared seedbeds by a combination of (1) reducing brome seed yields with fire in the spring or early summer and (2) reducing density of emerging brome seedlings after autumn rains with herbicides or tillage.

Montana: I moved to Miles City during a drought in 1988 and saw few annual bromes in this area of the

Table 1. Ungrazed spring forage yield sampled in May and June at Fort Keogh.

	Species groups					
	Grasses					
Year	W. wheatgrass[1] S. bluegrass	Annual	Other	Sedges	Forbs	Total
			(pounds/acre)			
1983	239	343	210	25	104	922
1984	170	301	60	16	27	573
1985	196	170	52	11	52	480
1986	581	183	74	21	89	950
1987	434	236	59	18	69	816
1988	246	23	53	6	36	364
1989	382	373	51	11	57	822
1990	468	452	60	27	51	1,057
1991	310	632	33	0	19	994
1992	267	242	32	0	20	560
1993	302	126	79	24	75	608
1994	522	28	97	4	46	695
1995	433	117	79	29	82	740

[1]Western wheatgrass and Sandberg bluegrass.

Northern Great Plains until 1989, a year with above average annual precipitation. It became apparent, after looking at published research in the late 1980s, that annual bromes did not have much impact in the region before the mid 1950s. However, data collected in the 1980s clearly indicated that annual bromes could provide a large proportion of the spring forage produced in the Northern Great Plains. As with most annual grasses, herbage production from annual bromes is erratic from year to year (Table 1). Early maturation of annual brome plants impacts rangelands in two main ways. Brown mature herbage is poor quality for grazing livestock and provides fine fuel for fires.

The literature I reviewed, exposed many gaps in information on annual bromes in the Northern Great Plains. Particularly missing was information on the impact of annual bromes on production of native vegetation and livestock. We also did not know if annual brome seeds produced in the Northern Great Plains germinated and responded to environmental factors similarly to bromes growing in other regions of the United States. From a series of studies on annual bromes conducted in the Northern Great Plains at the Fort Keogh Livestock and Range Research Laboratory near Miles City, Montana, here is what we've found:

How does environment affect establishment and growth of annual bromes?

Abundance of brome depends on availability of seed, amount and distribution of rainfall, temperature, and availability of soil nitrogen. Brome is most abundant in years following wet autumns and most productive in years with abundant autumn and spring rainfall. Cool temperatures during the growing season will prolong growth of annual bromes, and adding nitrogen to the soil increases forage production as shown in some fertilizer studies in the region.

All of the environmental factors work together to impact annual brome production. While it is relatively easy to determine whether density of annual brome plants will be great in a given year, it is difficult to know how much and how long forage will be produced by the bromes.

What conditions promote seed germination and seedling establishment?

More than 10,000 annual brome seeds can be present in a square yard in the mixed-grass prairie of the Northern Great Plains. Seeds will generally germinate over a wide range of temperatures that often occur in late summer and autumn, but soils usually need to be moist for 3 to 5 days for seeds to germinate. Litter enhances germination and seedling emergence by conserving soil water. Seeds can germinate in spring, particularly after dry autumn and winter periods, when soil water is available during spring.

The high level of germination exhibited by Japanese brome in our studies suggests a large portion of the ripe seeds will germinate with available water during late summer and early autumn. However, a percentage of the seeds that do not germinate by late-September can become dormant when water is taken up at or below 32°F. This dormant state can last through the next winter, spring, and summer. This characteristic aids annual brome's persistence on rangelands, because seedlings emerging in August and September in any year likely come from two seed crops, the current and previous years. Emerged seedlings will over-winter and begin growth in early spring.

Harvesting stands of Japanese brome for hay may reduce the seed bank in one area and increase the seed bank where the hay is fed. We found that Japanese brome seed could germinate when harvested green in mid-June. **It is best to feed Japanese brome hay only on brome infested areas.**

Do annual bromes compete with established native perennial grasses?

Annual bromes add to the total forage base at the expense of perennial grasses. When we removed annual bromes from mixed-grass prairie communities, total yields were reduced an average of 23% and western wheatgrass yields increased 23%. The short-term increase in production of western wheatgrass was due to an increase in number of shoots, rather than an increase in weight of individual shoots. The ability for brome to suppress for-

age production can be expected over a wide array of environmental conditions with variable late spring and early summer precipitation (i.e., 4 to 15 inches) and variation in total forage production (i.e., 1,100 to 2,100 pounds/acre).

Do annual bromes impact livestock performance on rangelands?

Many studies have shown a decline in weight gains of stocker cattle as the grazing season progresses from spring to autumn in the Northern Great Plains. Two questions come to mind. How much of this decline is due to maturation and senescence of perennial grasses? How much of the decline is due to the presence of large amounts of early maturing annual bromes?

When we reduced the amount of annual brome chemically, gains of stocker cattle were increased from 2.02 to 2.29 pounds/head/day and from 15.6 to 18.1 pounds/acre from May to September, 1993-1995. We think a portion of the increase in gain was due to an increase in crude protein of diets. Crude protein in diets was increased from 12.6% to 14.2% due to both a shift in botanical composition of diets as well as an increase in crude protein concentration in response to the herbicide. Percentage of annual grasses was reduced in the diets in most years, and replaced by a variety of species (i.e., western wheatgrass, forbs, and blue grama).

Will bromes always affect livestock performance on rangelands?

The 16% increase in gains of stocker cattle obtained with reduction of annual bromes can occur on other Northern Great Plains ranges. However, results following brome reduction will vary depending on the magnitude of annual production of bromes and the distribution of bromes within a given pasture. Untreated pastures in our study (1993-1995) were uniformly infested with annual bromes, however production of annual bromes was relatively small compared to other years (Table 1). Increase in livestock performance may have been greater if a greater brome production was removed, but it might have been smaller if cattle were grazing large pastures with spotty distribution of bromes. When bromes are less abundant or abundant in patches, livestock can more easily select perennial species in their diets.

What will happen on brome infested ranges in the future?

We do not anticipate an ecological shift of northern mixed-grass prairies toward an annual grass dominance. We know that the amount and abundance of annual bromes occurring on Northern Great Plains rangeland is cyclic and depends on the seedbank, temperature, and amount and distribution of precipitation. In addition, western wheatgrass and blue grama, two of the dominant perennial grasses, reproduce vegetatively and have long life spans. These species effectively buffer the impacts of Japanese and downy brome in mixed-grass prairie communities, particularly where grazing management strategies maintain healthy-vigorous stands of native mixed-grass prairie vegetation. This is in contrast to the overwhelming successful invasion of downy brome into areas dominated by shrubs and bunch grasses in the Intermountain West.

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Figure on page 32 is an illustrations of Japanese and downy brome plants, spikelets, and florets (Courtesy of Emerenciana G. Hurd).

Alternatives For Managing Annual Bromes

Suppression of brome requires environmental and/or managerial reduction of the annual brome seedbank. Even after two years of suppression by burning, herbicides, or grazing the seedbank may contain enough seed to maintain brome populations or allow an increase in its abundance. Nonetheless, here are some management strategies:

Grazing: The best management practice is to graze brome infested ranges in early spring. This way you are negatively impacting the brome while using available forage. Cattle should be removed while adequate soil water is available for growth of perennial grasses. This practice will allow management of but not eradication of bromes. Reducing seed production by defoliation should be an effective method of interrupting the life cycle of annual bromes. Actually, we found you can reduce above- and below-ground biomass and seed production of Japanese brome plants with frequent-intensive clipping in controlled environments. In the field, the brome population is reduced both through reduction in the amount of seed and the amount of mulch or litter.

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The biggest challenge to control brome by grazing or mowing is that a narrow window exists in early spring when defoliation can suppress annual brome growth, seed production, and mulch buildup. This approach would require high density grazing for a short duration or carefully timed mowing, during which time bromes would be closely defoliated and/or seed production prevented. Uniformly defoliating brome plants with grazing or mowing and precisely timing defoliation to reduce selection of perennial grasses and allowing the perennials adequate time to recover from defoliation before the end of the growing season is not easily accomplished on any rangelands.

Unfortunately, terminating grazing or mowing when soil water is available for growth of associated perennial grasses may also prove advantageous for annual bromes. It is unlikely all annual brome plants and shoots will be grazed. Consequently, some annual brome plants will always be present to produce viable seed and replenish the seedbank.

Burning: Findings of other researchers have shown increases in forage yields of perennial grasses after suppression of Japanese brome with burning. Burning kills seedlings, reduces seed, and removes mulch. Generally, greater reduction of annual bromes can be expected from burning when precipitation is below normal following the year of burning. This phenomena is a result of reduction in litter accumulation, which will reduce annual brome recruitment, seed production, and seed banks.

Herbicides: Some chemicals that would be beneficial in controlling brome (i.e., atrazine) are no longer labeled for use on rangelands. Wyoming researchers reported promising annual brome control in the late 1990s with both glyphosate and paraquat which are available. Care must be used in choosing times of application to reduce damage to associated desirable perennial grasses.

Finally, realize that annual bromes will persist on Northern Great Plains ranges. Maintenance of a viable livestock industry will require special management skills because this region is characterized by large and rapid changes in forage production, resulting from periods of above and below average precipitation and the invasion of alien weeds. You will have to decide if annual bromes are a problem on your operation. Can they be controlled, or better yet, can they be economically controlled? It is important to determine the botanical composition of pastures and plan their use based on livestock nutrient requirements and the potential of plant species to provide the required nutrients. This inventory is critical for devising management strategies to maximize efficiency of utilization of Northern Great Plains rangelands.