PUBLICATIONS
1994

Forage Research in Texas, 1994

RESPONSE OF COMMON BUFFELGRASS TO PASTURE RENOVATION PRACTICES

C. Wayne Hanselka

Summary

This paper presents information on the responses observed in common buffelgrass (Cenchrus ciliaris) biomass production using several different pasture renovation practices. These evaluations were conducted at nine South Texas locations during 1987-1993. In late winter, treated plots were renovated using commercially available aerators, chisels, rootplows, and paratill plow. Biomass on treated and adjacent non-treated areas was harvested quarterly to determine forage production. Greater buffelgrass production was observed for all renovation treatments, at all locations, and for all years relative to non-treated plots. During periods of drought, total forage production declined in the non-treated check plots; but where soil renovation practices were employed, greater buffelgrass production was sustained. Renovation was most effective in rejuvenating sparse, deteriorating buffelgrass stands.

Introduction

Common buffelgrass was introduced into South Texas from South Africa in the late 1940's and presently occupies 1.6 million acres of rangeland and pastures in the region. Buffelgrass can increase grass productivity five-fold over native brushland in South Texas (Hanselka, unpubl. data). Gonzales (1993) reported that buffelgrass has allowed Webb county livestock producers to increase their livestock stocking rates from 36 ac/a.u. on native rangeland to 25.5 ac/a.u. However, despite the advantages of high productivity and resistance to drought and overuse, buffelgrass needs to be carefully managed or stands will decline in productivity.

While overgrazing and drought are obvious causes of production decline, soil compaction by equipment traffic and livestock trampling is less obvious (Hanselka, Livingston, and Bade 1993). Buffelgrass will become "root-bound" in tightly packed soils. This, in combination with roots weakened by overgrazing, will inhibit root growth and distribution and effective use of rainfall (Fryrear and McGully 1972). A variety of practices have been used to alleviate soil compaction on ranges and pastures. Perennial grasses produced significantly more biomass after

Keywords: Common buffelgrass/Renovation/Subsoiling/Biomass Production

pitting or ripping treatments in Wyoming (Rauzi, 1973). Another Wyoming study compared plowing, rotovating, and blading to renovate rangeland (Rauzi, 1975, 1980) with each of the soil treatments resulting in increased herbage yields. Ripping and furrowing shortgrass rangeland led to the greatest increase in production during the first year after renovation and significant increases during subsequent high rainfall years (Griffith, et. al., 1984). It was estimated that increased carrying capacity would result in a full return for renovation costs in four years.

Despite declines in buffelgrass productivity attributed to soil compaction there have been few investigations into buffelgrass responses to range or pasture renovation practices. Parra, et al (1984) reported significant increases in buffelgrass production on subsoiled plots over non-treated plots in Sonora, Mexico. Subsoiled areas also out-produced roller chopping and burning treatments in that study. This paper reports the results of a series of studies on common buffelgrass biomass production responses to several pasture renovation practices.

Procedure

A series of three studies were conducted on the Rio Grande Plains of Texas from 1987 through 1993. The first study was located near Encinal (Webb county), Hebbronville and Benavides (Duval county), Bustamante (Zapata county), and El Sauz (Starr county) in South Texas. Five deteriorated common buffelgrass pastures were chiseled (ripped) in January and February, 1987. The ripping was accomplished by pulling a 3-shank chisel through each pasture. The shanks were set on a three foot spacing and ripped the clay loam soils to a depth of 15-20 inches. This treatment effectively broke surface crusts and hardpans as well as fractured the soil between the ripped furrows.

The second study measured buffelgrass responses to subsoiling with a finless root plow (essentially a moldboard plow) and a paratill plow. These treatments were located on two ranches near Mirando City and Zapata (Jim Hogg and Zapata counties, respectively) from 1988 through 1991. Each treatment effectively subsoiled to a depth of 18 to 24 inches.

The third study was located near Hebbronville in Jim Hogg county from 1992 through 1993. Applications consisted of treating the deteriorated, brush infested pasture with a "pasture aerator." The blades of this tool cut 9 in. long x 3 in. wide furrows in the soil eight in. in depth while chopping brush regrowth into small pieces.

Biomass responses were measured in all experiments by placing 10 wire grazing exclosures (1 m^2 area) on each treated area and 10 exclosures on an adjacent non-treated area. The grasses within the exclosure were harvested quarterly to a cutting height of 4 in. The exclosures were moved after each harvest to a newly clipped adjacent area to negate the effects of frequent defoliations. Harvested samples were dried, weighed and biomass production calculated as pounds of dry matter per acre. The four harvests from each location were added to obtain total annual production.

Results and Discussion

The use of a chisel to rip and fracture compacted soil resulted in an average increase of 1683 lbs of dry forage per acre across five locations during the treatment's first year (Table 1). Positive responses were also apparent the second year (+1358 lb/acre) but decreased dramatically by the third year. The South Texas region had experienced a deepening drought from the fall of 1987 through 1989 and reduced buffelgrass biomass production reflects the lack of rainfall in 1989 on the study areas. Production was very low on all plots during 1989, but grasses on the treated areas consistently out-produced those from the non-treated areas. A positive production response to the treatments occurred at all locations over the three year period.

The production increases of 23% - 119% in 1987, 56% - 126% in 1988, and 19% - 423% in 1989 reflect several trends. Ripping to a depth of 20 inches allowed more water into the soil which buffelgrass plants efficiently utilized, resulting in increased biomass production. In general, the treated areas that received the most rainfall, in any year, responded with the greatest biomass increases over the non-treated plots.

Sparse grass stands on compacted soils received the most benefit from subsoiling. Such stands (e.g. Encinal and Hebbronville) responded quickly and positively to treatment. An increase in volunteer reseeding occurred and by the second year the treated stand produced as much or more forage than it did the first year. An increase in stand density and basal cover was noted subsequent to chiseling. This corresponds to results reported by Parra et al. (1984). Strong, healthy stands (e.g. El Sauz) exhibited a weak response to chiseling.

The paratill, rootplow, and 3-shank chisel were also used to evaluate buffelgrass responses to renovation practices from 1988 to 1991. The paratill plow is a subsoiler that shatters soil compaction using lift/fall principles. The same is true for the rootplow minus the lifting fins as this plow is pulled through the soil causing the top layer of soil to be lifted and then it settles with minimal disturbance. Each treatment allows improved water percolation into the soil.

Improved growing conditions are reflected in biomass production responses of buffelgrass to paratill plow, root plow and chisel treatments (Table 2). Positive responses occurred on all treatments and advantages were recorded for each of the four post-treatment years. These trials were initiated during the first year of the multi-year drought and decreased production on the control plots (especially at the Zapata site) reflects the drought impact. The dry period lasted through 1989 and into 1990 when the non-treated areas responded to increased rainfall. The non-treated Zapata site exhibited the smallest difference between treated and non-treated plots over the life of the experiment. Production greatly improved after renovation at the Mirando City location, resulting in a doubling of forage production at that site.

The "pasture aerator" is a modified roller chopper with a series of small blades attached in spiralling rows on a revolving, heavy drum. Each row is 1 ft. apart and the blades are arranged in a staggered fashion in relation to each other. The result is that each blade cuts a narrow furrow 6 to 8 inches deep and fractures the soil as it is pulled out of the ground. The blades also cut and chop brush into small pieces. This tool was used to renovate two pastures near Hebbronville in 1992 resulting in a 245% increase in production between treated and non-treated areas the first year (Table 3). Response was lower the second year (126%), but the decrease may be attributed to fall drought in the area. More than 1200 lb/acre of additional forage was produced on the renovated plots.

It appears that subsoiling or other range and pasture renovation practices benefit buffelgrass yields. Buffelgrass responded positively to all the tools used in this investigation. Response is immediate and may last 5 years or more but the amount of response depends upon the density and health of the initial stand and subsequent rainfall. Increased biomass production was a function of improved health and vigor of the plants and increased numbers of plants. Approximate costs of the use of the three types of equipment are $25.00/acre.

The decision to renovate buffelgrass pastures and which tool to use will depend on stand density, health and vigor of the grass plants, and soil type. Branson et al. (1966) found that medium to fine textured soils are the most suitable for mechanical treatments. Common buffelgrass generally grows on clay loam soils that are subject to compaction and will benefit from soil renovation. The choice of equipment will also depend upon availability and energy requirements to pull the tools. Costs/benefits should be carefully analyzed in the decision-making process. Finally, renovating buffelgrass pastures must be carefully planned and integrated into the total ranch management system.

Acknowledgements

The financial assistance of G.E. Pogue Seed Co. for portions of this study is appreciated. Also, access to the various ranch properties as well as the installation of treatments by the many ranch owners/managers is also appreciated. Dr. Steve Livingston installed the paratill plots and the respective county Extension Agents assisted with data collection. The typing skills of Mrs. Sylvia Falcon and the assistance of the reviewers of this manuscript is acknowledged.

Literature Cited

Branson, F.A., R.F. Miller, and I.S. McQueen. 1966. Contour furrowing, pitting, and ripping on rangelands of western United States. J. Range Manage. 19:182-190.

Fryrear, D.W. and W.G. McGully. 1992. Development of grass root systems as influenced by soil compaction. J. Range Manage. 25:254-257.

Gonzales, G.L. 1993. The comparison of beef production in Webb County on native rangeland versus buffelgrass pastures. M. Sci. Thesis, Laredo State Univ. 57 p.

Griffith, L.W., G.E. Schuman, F. Rauzi, and R.E. Baumgartner. 1984. Mechanical renovation of shortgrass prairie for increased herbage production. J. Range Manage. 38:7-10.

Hanselka, C.W., S.D. Livingston, and D. Bade. Renovation practices to improve rainfall effectiveness on rangeland and pastures. Texas Agricultural Extension Service, L-5077, 6 p.

Parra, M.A., F. Ramirez, J.A. Becerra, and Victor M. del Cid. 1984. Efecto de la quema, chapeo y subsuelo en praderas de zacate buffel (Cenchrus ciliaris L.). Avances de Investigacion Pecuaria en el Estado de Sonora, 1983-84. Centro de Investigaciones Pecuarias del Estado de Sonora, 15-19p.

Rauzi, F. 1973. Mechanical and chemical range renovation in southeastern Wyoming. J. Range Manage. 26:48-52.

Rauzi, F. 1975. Severe mechanical and chemical range renovation in northeastern Wyoming. J. Range Manage. 28:319-326.

Rauzi, F. 1980. Herbage yields from a clayey range site 10 and 11 years after severe renovation. J. Range Manage. 33:379-381.

Table 1. Production of forage (lbs/acre air dried) from chiseled and non-chiseled buffelgrass pastures, at five locations in South Texas, 1987-1989.

LOCATION	PRODUCTION								
	1987			1988			1989		
	Diff.	Change	Rainfall In.	Diff.	Change	Rainfall In.	Diff.	Change	Rainfall In.
Encinal	+1803	109%	24	+ 391	126%	16	+305	423%	5
Hebbronville	+3170	119%	22	+1188	56%	8	+ 58	46%	2
El Sauz	+ 665	24%	17	+1933	94%	19	+170	19%	4
Bustamante	+1521	43%	16	+1420	99%	23	+577	49%	13
Benavides	+1257	23%	12	+1856	65%	15	+175	66%	8
Average	+1683			+1358			+ 573		

Table 2. Comparative responses of common buffelgrass (lbs/ac) to subsoiling with the paratil, rootplow, and chisel.

Year	Rootplow	Paratil	Control
Mirando City	----------------------lb/acre----------------------------		
1988	2075	2101	1580
1989	1667	1544	832
1990	4629	3357	927
1991	5946	5028	2840
Average	3579	3008	1545
Zapata			
1988	1348	1446	300
1989	1764	1142	1187
1990	4394	4150	3470
1991	7137	5992	5336
Average	3661	3183	2573

Table 3. Buffelgrass responses to treatments by the "Pasture Aerator", Hebbronville, Texas.

Year	Treated	Control	Difference	Percent Change
	---------------------lb/acre---------------------			%
1992	5435	1571	3844	245
1993	2262	990	1252	126