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Some Factors Affecting Establishment of Desirable Forage Plants in Weedy Bluegrass Pastures of Eastern Nebraska[1]

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In general the farm pastures of eastern Nebraska have had a history of deterioration similar to the larger grazing areas of the region. This history has usually consisted of varying periods of heavy grazing pressure followed by a reduction of the native warm-season grasses and their eventual replacement by Kentucky bluegrass, *Poa pratensis*, and both annual and perennial weeds. This process has been slow, and the decline in total production was seldom noticed, probably because the farmer or rancher had no handy method of measuring the actual forage yield.

Many attempts have been made to increase forage yields, especially in areas where pastures were of such size as to represent a significant part of the area producing the farm income. Various methods have been employed such as increased levels of fertility, control of weed populations, mechanical renovation, establishment of more productive grasses and legumes, or some combination of these practices. Most workers have eventually come to the conclusion that if maximum production is to be obtained, the persistent though unproductive species should be replaced by more productive ones.

The primary objective of this study was to determine the effects of seedbed preparation methods and weed control practices on the establishment of desirable species in areas where Kentucky bluegrass and weeds predominated. The initial question to be answered was how much tillage was necessary to kill the bluegrass, or reduce it to such an extent that reseeded grasses and legume seedlings could become established. It was apparent, however, that in a weedy pasture sufficient tillage to drastically reduce the bluegrass resulted in large increases in annual weeds, which were often responsible for subsequent failure of the seedlings to survive their first year. Therefore the second question to be answered was what weed control method could be applied in the seedling year that would control weed populations in order that the reseeded grasses and legumes could survive their critical seedling period. This would be particularly critical in years of moisture deficits: a condition which occurred during the course of this study.

Cotton (1910), Cook (1922) and Odland, *et al.* (1930) used various methods of fertilization, mechanical renovation and reseeding to improve old sods. Except where their tillage methods effectively killed the old sods the resulting increases in productivity were due to fertilization and were not due to the reseeded species. Graber (1927, 1928, 1936) improved old bluegrass sods by establishing sweetclover. This practice was successful only if the bluegrass was sufficiently reduced in vigor to allow establishment of the legume. Ahlgren, *et al.* (1944) reported yields of renovated pastures in Wisconsin that were five times greater than the untreated areas the first year following renovation. The yields dropped rapidly however in subsequent years as the bluegrass and redtop recovered. Hughes and Peterson (1946) found that fall plowing followed by spring disking and reseeding effectively killed bluegrass sods, and good stands of the reseeded species were obtained. Less drastic tillage methods resulted in rapid recovery of the bluegrass and poor stands of seeded species. Renovation work in Pennsylvania was reported by V. G. Sprague, *et al.* (1947). Plowing was the most effective method tried. M. A. Sprague (1952) used sodium trichloroacetate as a substitute for tillage in killing bluegrass. The seedbed preparation was greatly simplified by first killing the old sod chemically. The method

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probably would be advantageous on stony land or on highly erodable slopes.

Experimental Area

The area selected for this study was a portion of the Arthur Hornung farm pasture, 8 miles south of Lincoln, Nebraska[2]. The pasture had been used for the grazing of beef cattle for fifty years and had never been plowed.

The botanical composition of this pasture was well known as detailed vegetative analyses had been made over a four-year period by Klingman (1952) and McCarty (1953). There was a well established bluegrass sod and large amounts of hairy chess (*Bromus commutatus*). These two species represented about 90 percent of the grasses present. Annual and perennial broadleaved weeds were abundant, and about 55 percent of the total dry matter produced each year was produced by unpalatable species. The soil was a deep, fertile, Judson-Wabash silt loam.

Methods and Materials

The experimental area was divided in half and two separate experiments were set up; one using smooth bromegrass as the replanted species and the other using a warm-season grass mixture. This mixture consisted of switchgrass, sand lovegrass, side-oats grama, and blue grama at the respective rates of 5, 2, 2, and 5 pounds per acre. The two experiments were conducted simultaneously except for dates of planting, spraying and mowing. All of the treatments were applied to the warm-season grass mixture one month later than to the bromegrass. A split-plot design was chosen with seedbed preparations as the whole plots and weed control treatments as the subplots. Each experiment was replicated four times.

No detailed data were collected in the year that the reseeding was done. Survival through the year following seeding was considered to be a better index to successful establishment than counts in the seedling year. Therefore the seedbed preparations, plantings, and weed control treatments were done in the spring of 1952, and the data collected in the summer of 1953.

Three methods of seedbed preparation were utilized in this study: plowed, disked, and no tillage. These were selected primarily because they represented three distinct degrees of reduction of the bluegrass sod, and secondarily because they could readily be accomplished by most land-owners with their available machinery.

The plowed portion of the area was plowed five inches deep with a moldboard plow, disked and then harrowed with a spike-toothed harrow. The disked portion was disked twice and then spike-tooth harrowed. The bromegrass was broadcast at the rate of 15 pounds of seed per acre. The warm-season grass mixture was broadcast at the rate of 4 pounds per acre, and the entire area was gone over with a treader to cover the seeds and firm the soil. Alfalfa and sweetclover were included in some plots as indicated below.

The weed control practices were as follows:

No weed control (checks)
Mowed (hay removed)
Mowed (hay not removed)
Sweetclover (no weed control)
Sweetclover (mowed)
Alfalfa (no weed control)
Alfalfa (mowed)

Table 1. Number of weed stems per 2' x 4' quadrat in bromegrass and warm-season grass mixture plots one year after reseeding, Lincoln, Nebraska, 1953.

	Warm Season Grass Mixture		Brome	
	Ironweed, False Boneset, Dandelion	Vervain, Annual Ragweed	Ironweed, False Boneset, Dandelion	Vervain, Annual Ragweed
Plowed				
No weed control	3.25	435.65	7.60	319.65
Mowed (R) #	3.55	450.10	4.50	306.80
Mowed (NR)#	1.05	304.75	4.80	256.45
Sw.Cl.—no weed control	0.30	544.40	6.00	272.45
Sw.Cl.—mowed	1.55	405.90	1.50	219.60
Alfalfa—no weed control	1.15	485.85	4.95	193.55
Alfalfa—mowed	2.75	243.45	3.65	193.10
Average	1.94*	411.44*	4.71*	251.66
Disked				
No weed control	10.75	145.60	47.70	194.80
Mowed (R)#	27.05	247.15	43.35	238.20
Mowed (NR)#	12.70	125.35	28.75	253.60
Sw.Cl.—no weed control	9.10	181.45	45.05	182.60
Sw.Cl.—mowed	19.85	193.20	36.35	162.95
Alfalfa—no weed control	17.15	172.05	32.15	152.70
Alfalfa—mowed	25.00	192.95	28.70	219.05
Average	17.37	179.68	37.44	200.56
No seedbed preparation				
No weed control	23.05	75.40	42.50	85.05
Mowed (R)#	22.65	95.85	44.90	150.70
Mowed (NR)#	14.35	66.70	21.90	85.30
Sw.Cl.—no weed control	12.70	93.90	40.30	57.10
Sw.Cl.—mowed	28.75	63.75	39.20	124.60
Alfalfa—no weed control	15.15	48.50	44.00	56.30
Alfalfa—mowed	27.95	92.00	37.05	188.25
Average	20.66	80.44	38.55	106.76

R-herbage removed; NR-herbage not removed.
* Significant at the 5 percent level.

[2]*Appreciation is expressed to Mr. Arthur Hornung for providing the area for this and other studies.*

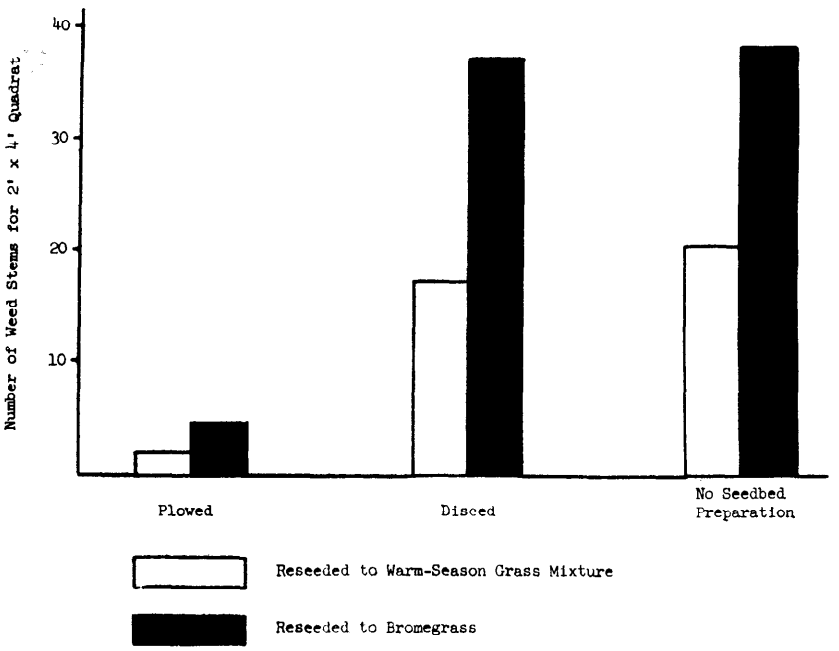

FIGURE 1. Effect of seed bed preparation on the number of stems of the three most abundant perennial weeds (ironweed, false boneset, and dandelion) one year after reseeding.

As a supplement to the seven treatments listed above there were five additional treatments applied to the plowed portions of the experiment.

2,4-D ester (1 lb. per acre)
Sweetclover-mowed 4″ high, hay not removed
Sweetclover-mowed 1″ high, hay removed
Alfalfa-mowed 4″ high, hay not removed
Alfalfa-mowed 1″ high, hay removed

The supplemental treatments were included in order to obtain additional information on the effects of height of mowing and removal of the hay, where legumes were included in the mixture, and the effects of 2,4-D where no legumes were seeded.

Collection of the Data

The two classes of herbaceous vegetation measured in this study were grasses and grass-like forms, and broad-leaved plants that included both broad-leaved weeds and legumes. Since these two classes of vegetation were present in vastly different numbers, they required distinctly different methods of measurement. A basal density method using a modified line-transect was used on the grasses and grass-like plants, while a quadrat method was used to measure the broad-leaved populations. Such a system of measuring two classes of vegetation by two different methods yielded data of two types which were not directly comparable. However, the statistical analyses were handled separately; grasses were compared with grasses before and after treatment, and broad-leaved plants were compared on a before and after treatment basis, so no conflict was incurred by the use of different methods.

Experimental Results

Effects of Seedbed Preparation

The effects of plowing were very similar in both the bromegrass experiment and the warm-season grass mixture experiment. In both cases the stands of perennial weeds were materially reduced. The three most important perennial weeds, ironweed, (*Vernonia baldwini*), false boneset *(Kuhnia glutinosa)*, and dandelion *(Taraxacum officinale)*, were reduced 90 percent (Figure 1 and Table 1). Plowing also reduced the bluegrass, hairy chess, and sand dropseed (*Sporobolus cryptandrus*) by approximately 80 percent (Figure 2 and Table 2).

Plowing was decidedly superior to disking or no seedbed

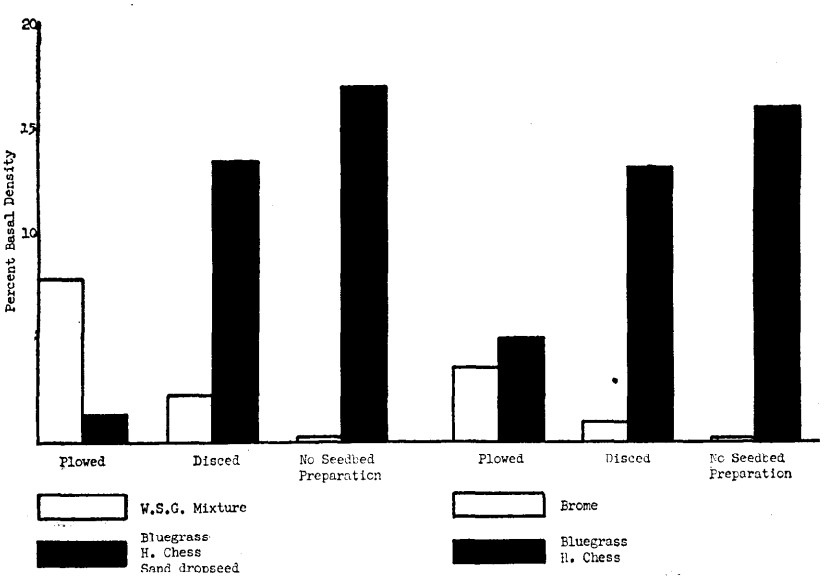

FIGURE 2. Effect of seedbed preparation on basal density of grasses one year after seeding (1952).

Table 2. Percent basal density of grasses in bromegrass and warm-season grass mixture plots one year after reseeding, Lincoln, Nebraska, 1953.

	Warm Season Grass Mixture		Bromegrass	
	Reseeded Species	Bluegrass, Hairy Chess, Sand Dropseed	Bromegrass	Bluegrass, Hairy Chess
Plowed				
no weed control	4.23	1.88	4.10	8.48
Mowed (R)#	12.91	1.08	3.65	3.38
Mowed (NR)#	11.41	0.98	2.58	3.95
Sw.Cl.—no weed control	4.72	1.87	3.50	5.95
Sw.Cl.—mowed	8.31	0.82	4.20	2.80
Alfalfa—no weed control	5.10	1.68	3.18	5.70
Alfalfa—mowed	7.56	0.73	3.62	4.22
Average	7.75*	1.29**	3.55**	4.92**
Disked				
No weed control	1.08	17.07	1.02	16.18
Mowed (R)#	2.85	11.32	0.80	9.80
Mowed (NR)#	3.12	15.10	0.80	12.63
Sw.Cl.—no weed control	0.87	14.01	0.35	14.72
Sw.Cl.—mowed	2.76	11.36	0.62	12.86
Alfalfa—no weed control	0.75	14.68	1.70	14.40
Alfalfa—mowed	4.36	9.63	0.95	11.37
Average	2.26	13.31	0.89	13.14
No seedbed preparation				
No weed control	0.00	17.75	0.05	15.80
Mowed (R)#	0.55	15.35	0.08	14.90
Mowed (NR)#	0.23	15.80	0.08	17.90
Sw.Cl.—no weed control	0.05	15.87	0.08	16.48
Sw.Cl.—mowed	0.25	17.15	0.15	16.98
Alfalfa—no weed control	0.04	18.77	0.02	16.90
Alfalfa—mowed	0.40	18.00	0.05	13.23
Average	0.22	16.96	0.07	16.03

R-herbage removed; NR-herbage not removed.
** Significant at the 1 percent level.
* Significant at the 5 percent level.

preparation in obtaining good stands of the reseeded grasses. There was 35 times more warm-season grass and 51 times more bromegrass established in the plowed plots than in the plots receiving no tillage (Figure 2 and Table 2). It was evident, from observations during the growing season, that the success of the replanted grasses in the plowed plots was largely due to the drastic reduction in Kentucky bluegrass.

Plowing also resulted in great increases of annual ragweed *(Ambrosia artemisiifolia)* and hoary vervain *(Verbena stricta)* (Figure 3). In the warm-season grass mixture plantings there were five times as many of these two weeds in the plowed plots as in the untilled ones. Plowing doubled the number of these two weeds in the bromegrass plantings.

Disking gave slightly better results than no tillage, but much poorer results than plowing. In the disked plots bluegrass rapidly recovered, the stands of planted species were poor, and annual weeds increased almost as much as in the plowed plots (Figure 2 and Table 2).

Effects of Weed Control Treatments

One year following the applications of the weed control treatments there were still significant reductions in weeds as compared to the untreated checks. The remaining weed populations did not, however, adequately indicate the benefits derived from the treatments. This was true because the treatments were applied in 1952 and the weed populations were studied a year later, by which time the annual weed populations had recovered somewhat from the previous year's treatment. Therefore the success of the weed control treatments was not indicated by the 1953 weed populations, but by

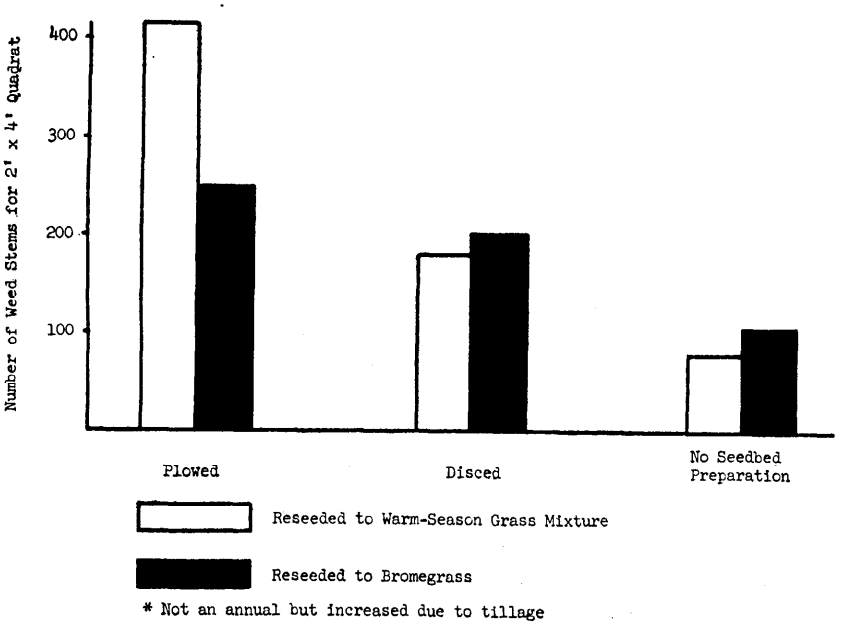

FIGURE 3. Effect of seedbed preparation on the number of stems of the most abundant annual weeds (annual ragweed and hoary vervain*) one year after reseeding.

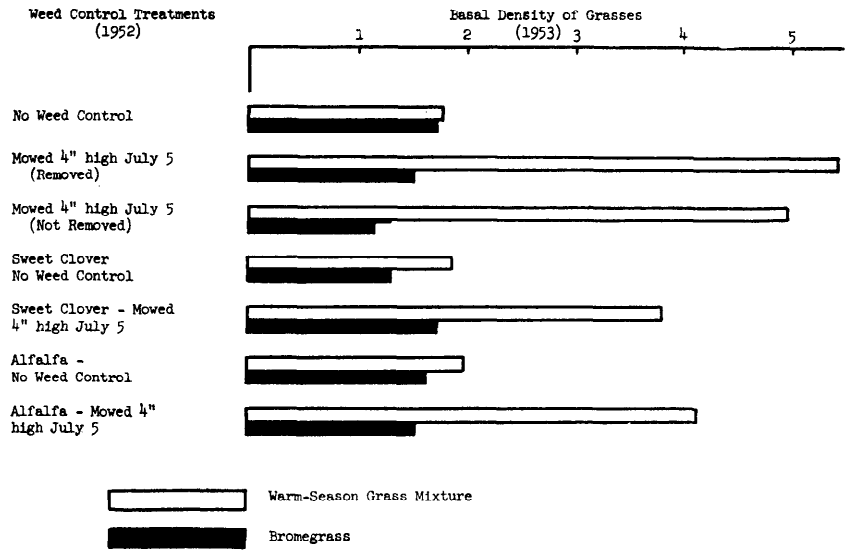

FIGURE 4. Effect of weed control treatments on basal density of bromegrass and warm-season grass mixture.

the success of the reseeded grasses that had survived their first year (Figure 4).

Mowing increased the establishment of the warm-season grass mixture by 2½ times. Since drought was a critical factor in the survival of the warm-season grass seedlings, a pronounced effect was achieved by removing a large part of the weed population while the grasses were in their seedling stages and highly susceptible to drought. Mowing did not produce such large differences in the bromegrass plots because the bromegrass population had already been lowered drastically by a late freeze while the bromegrass was in the seedling stage. Also, the remaining bromegrass plants were much farther advanced and had produced deeper roots by the time drought conditions became critical, and mowing was not as important in seedling survival (Figure 4).

Spraying with 2,4-D resulted in as high an increase of warm season grass seedlings as mowing (Figure 5), and it was evident that spraying would have a decided advantage over mowing where the weeds were too small to be effectively mowed. Also, spraying would be easier on large areas or areas where mowing was difficult. Mowing, however, gave excellent control of hairy chess while spraying was ineffective.

Alfalfa and sweetclover planted with both cool and warm-season grasses had little or no effect on weed populations or the success of the planted grasses. Removal or non-removal of the hay after mowing had no effect, and height of mowing, four inches versus one inch, showed no significant results.

Summary

A study was made of the effects of seedbed preparation and weed control practices on seedling establishment in a weedy pasture. The seedbed preparations involved plowing or disking as compared to no tillage. There were 12 weed control treatments that involved mowing, height of mowing, 2,4-D spraying, legume planting, and removal or non-removal of hay. The plantings included bromegrass, a warm-season grass mixture, alfalfa, and sweetclover. The plots were prepared, the plantings made, and the weed control treatments applied in 1952. The detailed vegetative analysis was made in the summer of 1953 without further treatments of any kind. Such a schedule provided a much better estimate of the ultimate survival of the planted species than if the data had been collected in the seedling year.

Plowing was decidly the best seedbed preparation method in this study. Plowing destroyed 90 percent of the perennial weeds, 80 percent of the old bluegrass sod, and was 30 to 50 times more

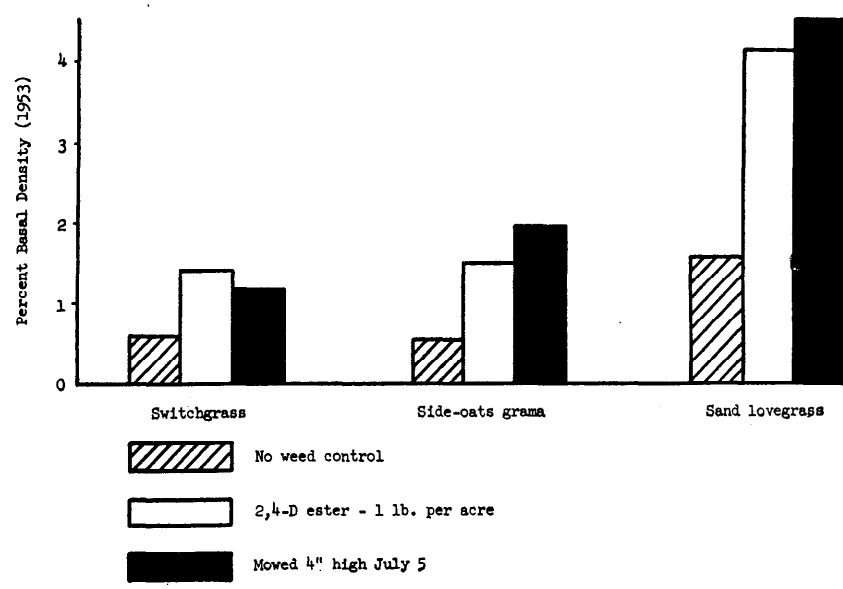

FIGURE 5.Effects of mowing and spraying compared to no weed control on basal density of three warm-season grasses.

effective in seedling establishment than where no tillage was done. Disking was not much better than no seedbed preparation, and both resulted in poor stands of the planted species.

Spraying with one pound of 2,4-D ester per acre and mowing were both effective in controlling weeds and allowing establishment of planted species. Under these treatments about 2½ times as many grass seedlings were established as where no weed control treatments were applied. Mowing at a one-inch height was no better than mowing at four inches.

The planting of legumes with the grasses made no difference in the success of the reseeding. Leaving or removing the hay after mowing had no differential effect.

The success or failure of reseeding more productive species in weedy bluegrass sods seemed to be proportional to the degree to which the bluegrass sod was destroyed and to the effectiveness of the weed control measures applied in the seedling stage of the planted species. The latter would be especially important in years of moisture deficit.

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Cowboy Hall of Fame Elects

Forty-one persons were voted into the National Cowboy Hall of Fame by trustees in annual meeting at Oklahoma City, January 7, as contracts were signed on architects' plans and specifications leading to construction start by autumn, for the first $1½ million unit of the western shrine.

All persons to be honored this year are deceased; all were identified with the livestock industry, had a hand in development of the American West or were prominent in perpetuation of traditions and ideals of the West, which were the basic criteria for selection and approval by a three-fourths majority of trustees.

Previously voted into the Cowboy Hall of Fame were WILL ROGERS of Oklahoma; THEODORE ROOSEVELT of New York and North Dakota; CHARLES GOODNIGHT of Texas, CHARLES RUSSELL of Montana and JAKE MCCLURE of New Mexico.

The at large honorees are EDWARD BEALE of California; DEAN W. L. BLIZZARD of Oklahoma; FRANK BOICE of Arizona; WILLIAM F. "BUFFALO BILL" CODY of Nebraska; DR. CHARLES F. CURTISS of Iowa; JAMES J. HILL of Minnesota; PETE KNIGHT of Alberta; HENRY MILLER of California; TOM MIX of Texas and Hollywood; EUGENE MANLOVE RHODES of New Mexico and BRIGHAM YOUNG of Utah.

Honorees by states were: Arizona, RAMON AHUMADO and GEORGE RUFFNER; California, HENRY C. DAULTON and FRED H. BIXBY; Idaho, FRANK GOODING and JOHN HAILEY; Kansas, DAN C. CASEMENT and CALVIN F. FLOYD; Montana, ROBERT C. FORD and CARSTEN C. KOHRS; Nebraska, FRANK NORTH and EDWARD CREIGHTON; Nevada, JOHN SPARKS and DANIEL WHEELER; New Mexico, JOHN CHISUM and VIC CULBERSON.

And North Dakota, WILSE RICHARDS and JOHN W. GOODALL; Oklahoma, CHARLES H. TOMPKINS and OTTO BARBY; South Dakota, JAMES PHILIP and ED LEMMON; Texas, STEPHEN F. AUSTIN and OLIVER LOVING; Utah, ANTHONY IVINS and JACOB HAMBLIN; Washington, ANDREW J. SPLAWN and BENJAMIN E. SNIPES; Wyoming, JOHN B. KENDRICK and FRANCIS E. WARREN.