Establishment and Growth of Selected Grasses

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Highlight: *The effect of cotton-bur mulch and manure on the establishment and growth of 13 selected grasses was measured. Mulch decreased the number of seedlings during the first growing season, but the number of established plants was increased at the end of the second growing season. Plant height was increased, even after 2 years, by a post-plant application of manure. After 2 years, six of the original 13 species had a satisfactory stand.*

Establishing perennial grasses on depleted rangelands or on land being converted from cropping in the Southern Great Plains hinges on the individual's ability to take advantage of the available resources. Efficient management of the limited rainfall in this section of the Southwest is a necessity.

Seeding success was generally poor on the Southern High Plains in New Mexico (Great Plains Agricultural Council, 1966). Plantings were made with a grass drill with no seedbed preparation. In Texas, more than 50% of the seedings on mixed land sites resulted in an excellent stand of at least one plant per square foot. On deep sandy sites only 60% of the plantings had 0.5 plant per square foot. The best results were obtained when a grass drill was used to plant into a dead litter.

Mulching, or covering the surface of the soil with litter or trash, is often useful in preparing for seeding, because it aids germination and protects young seedlings from drying (Anderson et al., 1953). Moldenhauer (1959) found mulch was especially beneficial to germination and emergence at low soil moisture content.

A study at Big Spring, Texas, showed some advantage of nitrogen fertilizer on seedling growth, but results were best when both nitrogen and phosphorus fertilizers were applied (Hudspeth et al., 1959).

Experimental Site and Procedure

The study site was located on the U. S. Big Spring Field Station, Big Spring, Texas. The average annual precipitation is approximately 18.5 inches, and comes as moderate to heavy rain in the spring and fall.

The soil is Amarillo loamy fine sand with a slope of approximately one percent. The pH ranges from neutral in the surface to alkaline in the subsoil (U. S. Dep. Agr., 1969).

The grass seeding was made in grain sorghum stubble on May 19, 1969. The stubble was not cut, and one lb/acre of 1, 1-dimethyl-4, 4'bipyridinium ion (paraquat) was applied one week before planting to control annual weeds and sorghum regrowth. The grasses were seeded in 40-inch rows at a depth of 3/4 inch with a double-coulter grass drill. The rate of seeding was 20 pure live seeds per linear foot. The experiment was replicated three times. The variety, common name, genus, and species of the grasses seeded in this experiment are listed in Table 1.

The study area was split for mulch application: one-third received no mulch, one-third received approximately 5 ton/acre of cotton-bur mulch, and the other one-third received approximately 5 tons/acre of manure. The mulch was applied five days after planting.

From planting until the middle of June, 1.8 inches of precipitation was received. This was followed by a 45-day dry spell with only one shower of 0.33 inch. From May 1 through June 1 of the second year, a total of 3.18 inches of precipitation was received. But this was followed by 90 days in which only 0.38 inch of rain fell.

To help control an infestation of Russian thistle (*Salsola kali* L.) during the first year, the area was mowed at a height above the tallest grass plant. Seedling counts and height measurements were made at the end of the first growing season to determine the number of seedlings in a 33-foot section of row.

The study area was mowed at a height of 6 inches before the start of the second growing season. One-half lb./acre of 2,4-dichlorophenoxy acetic acid (2,4-D) was applied in late April to control broadleaf weeds. In late summer of the second growing season, counts and height measurements were made of the number of established plants in 33 feet of row. Any species with 0.5 plant per linear foot was considered to be an acceptable seedling stand.

Results and Discussion

Because the cotton-bur mulch and manure retained the moisture in the soil for a longer period of time, most of the seed in these plots germinated before the onset of the dry spell. Many of the hard seeded species did not germinate in the no-mulch treatment plots until adequate rainfall was received from late August through the end of October. The no-mulch treatment, however, had a significantly higher seedling count at the end of the first growing season (Table 2). Because the mulches maintained soil moisture at a level favorable to germination longer than did the no-mulch subplot, during the subsequent drought

Table 1. Variety, common name, genus, and species of selected grasses.

Common name	Variety	Genus and species
Switchgrass	Caddo	*Panicum virgatum* L.
Switchgrass	Blackwell	*Panicum virgatum* L.
Sand bluestem	Woodward	*Andropogon hallii* Hack.
Sand bluestem	Elida	*Andropogon hallii* Hack.
Green sprangletop	Marfa	*Leptochloa dubia* (H. B. K.) Nees
Sideoats grama	Premier	*Bouteloua curtipendula* (Michx.) Torr.
Sideoats grama	El Reno	*Bouteloua curtipendula* (Michx.) Torr.
Indiangrass		*Sorghastrum nutans* (L.) Nash
Sand lovegrass		*Eragrostis trichodes* (Nutt.) Wood
Weeping lovegrass		*Eragrostis curvula* (Schrad.) Nees
Lehmann lovegrass		*Eragrostis lehmanniana* Nees
Blue panic		*Panicum antidotale* Retz.
Kleingrass		*Panicum coloratum* L.

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Table 2. Number of seedlings per 33 feet of row at the end of the 1969 and 1970 growing seasons.

Species	Mulch						Species means	
	No mulch		Cotton-burs		Manure			
	1969	1970	1969	1970	1969	1970	1969	1970
Kleingrass	567	40	351	38	371	43	430 a[1]	40 A[1]
Caddo switchgrass	21	27	5	30	8	25	11 c	27 B
Blackwell switchgrass	13	9	9	20	13	26	12 c	18 C
Woodward sand bluestem	1	9	3	9	4	8	3 c	9 CDE
Elida sand bluestem	2	11	4	14	5	8	4 c	11 CDE
Marfa green sprangletop	9	45	9	39	14	36	11 c	40 A
Premier sideoats grama	1	15	13	10	2	8	5 c	11 CDE
El Reno sideoats grama	13	39	27	37	12	28	17 c	35 A
Indiangrass	1	2	1	43	3	30	2 c	25 BC
Sand lovegrass	6	3	4	2	7	5	6 c	3 E
Weeping lovegrass	1	5	1	1	2	3	1 c	3 E
Lehmann lovegrass	92	11	25	11	46	10	54 b	11 CDE
Blue panic	8	2	51	16	61	30	40 b	16 CD
Mulch means	57 a	17 B	39 b	21 A	42 b	20 A		

[1]Mean values followed by different letters are significantly different at the 5% level; no comparison was made between years.

seedling mortality was greater on the mulched subplots. Also, cotton-bur mulch, because of its mattiness, may have caused some mechanical impedance. Kleingrass had the largest number of seedlings. Lehmann lovegrass and blue panic were next in seedling numbers and were significantly superior to the other ten species.

The number of established plants under the cotton-bur mulch at the end of the second growing season was significantly higher than the number of plants under no mulch (Table). The number of plants grown under manure was similar to the no mulch and cotton-bur mulch.

The numbers of kleingrass, Marfa green sprangletop, and El Reno sideoats grama plants were significantly higher than the other species, although the number of kleingrass plants was greatly reduced the second year. Caddo switchgrass was fourth in number of plants and was significantly higher than eight other species. There was no significant difference between the number of Caddo switchgrass and Indiangrass plants. Woodward and Elida sand bluestem, Premier sideoats grama, sand lovegrass, Lehmann lovegrass, weeping lovegrass, and blue panic did not develop into an acceptable stand of 0.5 plant per linear foot.

At the end of the first growing season, grass seedling growth was in the order manure > cotton-bur mulch > no-mulch treatment (Table 3). The increased plant growth on the mulched subplots and especially the manure subplot suggests enhanced soil fertility and improved plant-soil-water relations. Marfa green sprangletop, Lehmann lovegrass, and weeping lovegrass made significantly more growth than the other ten species. Indiangrass, Blackwell switchgrass, and blue panic made more growth than the remaining seven species.

Plants grown under manure were significantly taller than under the other two treatments at the end of the second growing season (Table 3). There was no significant difference in the average height of the plants grown under no mulch or cotton-bur mulch. This indicates a carry-over effect of the manure into the second year. The average heights of Marfa green sprangletop, Premier and El Reno sideoats grama, Indiangrass, sand lovegrass, and blue panic were significantly lower than the other species.

The number of kleingrass, sand and Lehmann lovegrasses, and blue panic plants decreased under all treatments from the first to the second year. Reduction was greatest under no mulch, indicating less desirable soil-plant-water relations than for the mulch and manure treatments.

If we consider 0.5 plant per linear foot as an acceptable stand, only three species had an acceptable stand with no mulch and manure at the end of the first growing season. Cotton-bur mulching resulted in acceptable stands of four species at the end of the first growing season. After the second growing season, the number of species having an acceptable stand were four, six, and seven for the no mulch, cotton-burs, and manure, respectively. The increase in number of plants probably resulted from delayed germina-

Table 3. Average height (inches) of established grass plants at the end of the 1969 and 1970 growing seasons.

Species	Mulch						Species means	
	No mulch		Cotton-burs		Manure			
	1969	1970	1969	1970	1969	1970	1969	1970
Kleingrass	2.0	16.5	4.7	20.9	5.1	26.4	3.9 c[1]	21.2 AB[1]
Caddo switchgrass	3.9	12.6	2.4	20.5	5.5	25.6	3.9 c	19.7 ABCD
Blackwell switchgrass	4.7	13.4	5.9	18.1	8.3	26.4	6.3 b	19.3 ABCD
Woodward sand bluestem	1.6	16.9	2.4	18.9	3.1	21.6	2.4 c	19.3 ABCD
Elida sand bluestem	2.0	15.4	2.4	19.3	2.8	24.4	2.4 c	19.7 ABCD
Marfa green sprangletop	4.3	9.0	5.9	14.2	17.3	20.9	9.0 a	14.6 DE
Premier sideoats grama	2.4	10.6	4.7	13.4	5.5	22.8	4.3 c	15.7 BCDE
El Reno sideoats grama	2.4	9.0	3.1	9.8	4.3	16.9	3.1 c	11.8 E
Indiangrass	2.8	13.8	7.9	16.9	7.9	11.8	6.3 b	14.2 DE
Sand lovegrass	2.4	8.3	2.8	12.2	3.9	25.6	3.1 c	15.4 CDE
Weeping lovegrass	3.5	18.9	7.9	6.7	14.6	36.2	8.7 a	20.5 ABC
Lehmann lovegrass	3.1	18.9	11.4	21.6	13.0	26.4	9.0 a	22.4 A
Blue panic	3.5	6.3	6.3	15.0	8.3	27.6	5.9 b	16.1 BCDE
Mulch means	3.1 c	13.0 B	6.1 b	16.1 B	7.5 a	24.0 A	5.2	

[1]Mean values followed by different letters are significantly different at the 5% level; no comparison was made between years.

tion of hard seeds and possible reseeding from previous year's crop in case of green sprangletop.

Conclusions

A dense mulch may reduce the number of emerging seedlings, but this is offset by the end of the second growing season by increased seedling survival due to improved soil-plant-water relations. Mulch is beneficial to plant vigor by conserving soil moisture, as reflected by increased plant height.

Different grass species, and sometimes varieties within a species, will respond differently to changes in the environment caused by adding a soil surface mulch. In this study, a satisfactory stand and rate of growth were obtained from kleingrass, Caddo switchgrass, and Blackwell switchgrass.

This study points out the need for additional research in grass establishment on sandy soils. These results show a need for evaluating soil-water characteristics, soil nutrient availability, and soil-conserving measures on grass seedling growth and establishment.

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