

Forage Research in Texas

1984

The Evaluation of Leucaena as a Warm-Season Legume

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SUMMARY

Twenty-eight sources of Leucaena leucocephala, 6 sources of L. pulverulenta, and 2 sources of L. retusa were evaluated for vigor, winter survival, leaf percentage and yield and forage digestibility. L. leucocephala varied in total dry matter production from 4.7 and 10.7 tons per acre harvested monthly and bimonthly, respectively, to 1.6 and 1.8 tons. L. pulverulenta varied from 4.0 and 4.8 tons to 1.2 and 2.4 tons, while L. retusa generally produced less than 1.0 ton. At 4 weeks of growth leaves and succulent stems made up 71 to 48% of dry matter but at 8 weeks of growth, only 59 to 38%. All of the sources survived the mild winter of 1982-83. L. retusa showed recovery growth in March 1984 following a severe winter for this location. One source each of L. leucocephala and L. pulverulenta showed some growth initiation from below ground on April 1, 1984. Percentage survival and regrowth vigor of all accessions will be evaluated later in the spring but it appears that at least some accessions will survive most winters as far north as 31° latitude. Forage digestibility analyses are not completed.

INTRODUCTION

Most tropical legumes lack winter hardiness and therefore have limited usefulness in most of Texas. Several Leucaena species are native to Texas and may have potential value. Leucaena is a woody plant and will require special management both for stand survival and for accessibility of acceptable plant parts (leaflets) to grazing animals. It is a legume and, when inoculated and nodulated fixes nitrogen. The seed are of acceptable size for wildlife use. Thus, the plant has some dual use potential, but information must be developed on adaptation, establishment and management before that potential can be realized.

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KEY WORDS: Warm-season legumes/ Leucaena/ Drymatter production/ Clipping

MATERIALS AND METHODS

Thirty-six sources of three Leucanea species (leucocephala, pulverulenta and retusa) (Table 1) were established in the field at College Station by transplanting individual seedlings April 30, 1982. The seedlings were established in 10 plant plots 40 inches apart in 40-inch row spacings, 2 replications. Following irrigation for establishment the plants have been grown without irrigation or fertilization. Plant height was measured on August 11 and one-half (5) of the plants in each plot were cut back to a 12-inch height. Plant heights were again measured on November 13.

In March 1983 the old top growth on all plots was removed at a 12-inch height. Plants in one-half of each plot were cut on July 1, August 3, September 6 and September 30 while plants in the other half of each plot were cut on August 3 and September 30. Dry matter yields were determined and a sample from each plot was separated into leaves and succulent stems versus hard stems to determine percentage of animal acceptable dry matter. The leaf and stem samples were saved for protein and digestibility analyses.

RESULTS

Plants had reached an average height of 4.5 feet with a range in height from 1.5 feet to 6.7 feet by August 10 (Table 2). The L. leucocephala sources were taller on the average than L. pulverulenta sources which were taller than the L. retusa sources. Also, five L. leucocephala sources had 5 to 35% of the plants in the bloom or late stages of maturity on that date.

One half of the plants were cut to a 12-inch stubble height on August 11. On November 13 regrowth of the cut plants had an average height of 4.6 feet with a range of 1.7 to 7.0 feet. Plants that were not cut during the growing season had an average height of 7.4 feet and a range of 2.9 to 11.0 feet. L. leucocephala plant heights generally exceeded L. pulverulenta which exceed L. retusa for both regrowth and uncut plants. The regrowth (plant height) following cutting is shown in Figure 1(a) as a percentage of the source making the most regrowth. The sources are arranged in decreasing order of regrowth. The L. retusa and four of the L. pulverulenta sources were in the ranges of 40 to 60% of the check (source 26). L. pulverulenta K340 (Hutton) was approximately 82% of the check. The relative ranking of uncut plant for increase in plant height after August 11 is shown in Figure 1b. A few of the L. leucocephala and most of the L. pulverulenta and L. retusa

sources showed limited increases in plant height in late summer and early fall.

Almost all of the L. leucocephala sources had some plants with well developed seed pods by mid-November (Table 2) while only one L. pulverulenta source had plants in that stage and none of the L. retusa plants reached the flowering stage.

Dead tops of the plants were removed in March 1983. Essentially all of the plants survived the mild 1982-83 winter. Yield data were collected at monthly and bimonthly intervals beginning in July, 1983. Whole plant data are shown in Table 3. Two harvests at 8-week intervals resulted in 86% more dry matter production than four harvests at 4-week intervals. Yields in excess of 10 tons per acre were produced in two 8-week harvests while maximum yield were about 4.5 tons per acre with 4-week cutting intervals. Twenty-one L. leucocephala sources produced numerically more than the highest L. pulverulenta source, which follows the height pattern in 1982. The L. retusa sources were the lowest yielding materials in the test.

At eight weeks of age the woody stems of some sources exceeded 1 inch in diameter at the cutting height. Obviously, the woody material would not be acceptable forage. Leaf + succulent stem separations were made to determine the percentage of acceptable material in the harvested dry matter. The leaf material contains some petiole and succulent stem sections and represents an estimate of material acceptable to animals.

Material harvested at 4 weeks of age contained 60% leaf-succulent stems with a range of 34% to 71% while the 8-week material averaged 39% with a range of 27% to 52% (Table 3). There did not appear to be any appreciable relationship between yield or vigor among sources and percentage leaf-succulent stems. It is assumed that the leaf material and some succulent stems are acceptable to livestock and highly digestible. Much of the stem material even at 4 weeks would not be ingested by livestock because of its woody nature.

Since leaf-succulent stem material makes up the major component of usable forage, the yield of this material at 4 and 8 weeks of age was calculated from percentages and total dry weights (Table 4). Leaf-succulent stem yields ranged from 0.1 to 2.6 tons per acre at 4 weeks of age and 0.2 to 4.5 tons per acre at 8 weeks of age. While infrequent harvesting (8 weeks) versus frequent harvesting (4 weeks) resulted in an 86% increase in leaf-succulent stem percent, it resulted in a 23% increase in leaf-succulent stem production. Much of the growth after 4 weeks evidently was in the form of hard stems.

Ultimately it will be necessary to determine how to manage *Leucaena* to maintain stands and how to utilize it in a livestock program to provide an optimum amount of usable forage. These studies indicate that within a growing season, *Leucaena* plants will tolerate considerable defoliation. However, the effect of management on winter survival and on long-term survival of climatically adapted material must yet be determined and requires more comprehensive studies. At least one source each of *L. leucocephala* and *L. pulverulenta* showed some new growth from below ground on April 1, 1984. More detailed studies will need to be conducted on materials that have the ability to survive temperatures in the range of 10 to 15°F or lower.

Record of Fund Distribution

<u>Item</u>	<u>Amount</u>
Credit	
Grant	11239.12
Expenditures	
Salaries (Graduate Assistant)	3325.00
Wages (includes fringe benefits)	5770.46
Travel	0.00
Supplies and Materials	1626.45
Services	1057.88
Capital Equipment	0.00
Indirect cost	1465.00
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	13244.79

Note: Expenditures above the grant amount were from other fund sources

Table 1 Identification of *Leucaena* materials in evaluation trials at College Station

ID No.	Species	PI, other accession no., and source ¹
1	<i>L. leucocephala</i>	PI 443614 3225 III (Florida)
2	<i>L. leucocephala</i>	78-24c Yucatan (Hutton)
3	<i>L. leucocephala</i>	PI 281607 2571 I (Florida)
4	<i>L. leucocephala</i>	PI 414742 2671 II (Florida)
5	<i>L. leucocephala</i>	K 132 U.H., Vera Cruz (Hutton)
6	<i>L. leucocephala</i>	N.E. Brazil (Hutton)
7	<i>L. leucocephala</i>	Tree at Mc Carty Hall, Univ. of Fla. (Florida)
9	<i>L. leucocephala</i>	PI 281784 2593 VIII (Florida)
10	<i>L. leucocephala</i>	PI 331797 2659 V (Florida)
11	<i>L. leucocephala</i>	K72 U.H. Salvador (Hutton)
12	<i>L. leucocephala</i>	Campina grande (Hutton)
13	<i>L. leucocephala</i>	PI 322552 2657 IV (Florida)
15	<i>L. leucocephala</i>	78-10 Salvador, Sta., Cruz Portillo STA. (Hutton)
16	<i>L. leucocephala</i>	78-15 Salvador, Jocoero (Hutton)
18	<i>L. leucocephala</i>	Pinaciaba (Hutton)
19	<i>L. leucocephala</i>	78-11c Salvador, Sta. Cruz Portillo, Sta. (Hutton)
20	<i>L. leucocephala</i>	78-85 Colombia, Plamira (Hutton)
21	<i>L. leucocephala</i>	PI 415703 2673 var. Cunningham (Florida)
22	<i>L. leucocephala</i>	PI 288004 2619 VIII (Florida)
23	<i>L. leucocephala</i>	K-8 Salvador (Hutton)
24	<i>L. leucocephala</i>	K341 Hawaii-Hawaii Island (Hutton)
26	<i>L. leucocephala</i>	Colombias no espinal Colombia-common (Hutton)
27	<i>L. leucocephala</i>	78-50 Tuxtla, Chiapas, Mexico (Hutton)
30	<i>L. leucocephala</i>	Belem (Hutton)

¹ Information in parenthesis indicates location or person supplying the seed.

Table 1 Identification of *Leucaena* materials in evaluation trials at College Station (Continued)

ID No.	Species	PI, other accession no., and source ¹
33	<i>L. leucocephala</i>	PI 3043650 3642 VI (Florida)
34	<i>L. leucocephala</i>	U.H., Australia, K4 (Hutton)
35	<i>L. leucocephala</i>	78-30 Yucatan (Hutton)
36	<i>L. leucocephala</i>	78-19 Belize (Hutton)
8	<i>L. pulverulenta</i>	Lot #0999 (TX A&I, Peter Felker)
14	<i>L. pulverulenta</i>	Lot #1000 (TX A&I, Peter Felker)
17	<i>L. pulverulenta</i>	AJO 3279 (Hutton)
29	<i>L. pulverulenta</i>	K340 (Hutton)
31	<i>L. pulverulenta</i>	Lot #1001 (TX A&I, Peter Felker)
32	<i>L. pulverulenta</i>	Lot #1002 (TX A&I, Peter Felker)
25	<i>L. retusa</i>	(Collected from Abilene ST School - orig. from Juntion, Kimball Co.)
28	<i>L. retusa</i>	(Ueckerd collected 11-26-80, 11 miles S. of Balmorhea, Texas)

¹ Information in parenthesis indicates location or person supplying the seed.

Table 2. Average plant heights and stage of maturity

ID No.	Species	-----Height ft.-----		-----Maturation stage %-----			
		Aug 10	Nov. 13 Regrowth uncut	Aug 10- Flower +	Uncut plants-- Nov. 13----- Veg Flower Pod		
1	L. leucocephala	5.2	5.5	8.4	5	100	
2	L. leucocephala	4.7	5.0	6.8	0	40	10
3	L. leucocephala	4.9	4.7	7.4	0	30	10
4	L. leucocephala	4.7	5.6	8.3	0	100	
5	L. leucocephala	4.7	5.2	9.3	0	40	60
6	L. leucocephala	5.2	6.1	9.7	0	90	10
7	L. leucocephala	5.0	5.0	8.8	0	50	50
9	L. leucocephala	2.7	3.3	5.0	5	80	10
10	L. leucocephala	6.5	5.3	8.9	0	50	
11	L. leucocephala	5.4	5.2	8.2	0	100	
12	L. leucocephala	5.9	6.2	9.6	0	40	10
13	L. leucocephala	4.8	4.3	6.4	0	20	20
15	L. leucocephala	5.2	5.7	10.1	0	20	
16	L. leucocephala	6.6	6.2	11.0	0	50	10
18	L. leucocephala	5.3	5.0	7.2	0	90	10
19	L. leucocephala	4.8	4.7	7.0	40	50	40
20	L. leucocephala	3.7	4.0	6.1	30	90	
21	L. leucocephala	4.8	4.9	6.2	0	50	10
22	L. leucocephala	3.4	3.2	4.7	35	50	10
23	L. leucocephala	6.7	5.9	10.6	0	70	20
24	L. leucocephala	5.9	4.9	10.0	0	80	20
26	L. leucocephala	5.8	7.0	9.1	0	50	30
27	L. leucocephala	5.7	5.2	10.1	0	40	10
30	L. leucocephala	4.6	4.4	7.0	0	40	
33	L. leucocephala	3.6	3.7	5.9	0	100	60
34	L. leucocephala	4.5	4.7	8.9	0	50	

Table 2. Average plant heights and stage of maturity (Continued)

ID	No. Species	-----Height ft.-----		-----Maturation stage %-----			
		Aug 10	Regrowth uncut ---Nov. 13---	Aug 10- Flower +	Uncut plants ---Nov. 13---	Veg	Flower Pod
35	L. leucocephala	4.5	4.2	0	0	10	80
36	L. leucocephala	4.0	4.6	0	0	10	40
8	L. pulverulenta	2.2	3.1	0	0	100	20
14	L. pulverulenta	4.6	4.7	0	0	50	30
17	L. pulverulenta	3.8	4.1	0	0	100	20
29	L. pulverulenta	4.2	4.2	0	0	80	10
31	L. pulverulenta	2.7	2.6	0	0	100	10
32	L. pulverulenta	2.7	2.5	0	0	100	10
25	L. retusa	2.2	1.7	0	0	100	10
28	L. retusa	1.5	1.9	0	0	100	10

Table 3 Yield and percentage of leaves and succulent stems of *Leucaena* species harvested at two frequencies, 1983 (Continued)

Source ID	Species	PI or source	DM yield			Percentage leaves and succulent stems		
			4-wk	8-wk	avg	4-wk	8-wk	avg
			tons/acre			%		
9	L. leucocephala	281784	1.7	3.5	2.6	62	53	58
19	L. leucocephala	78-11 Salvador	3.2	1.8	2.5	60	40	50
17	L. pulverulenta	AJO3279	4.0	3.1	3.6	58	38	48
14	L. pulverulenta	Lot 1000	2.5	4.5	3.5	61	39	50
29	L. pulverulenta	K340	2.3	4.0	3.2	62	44	53
32	L. pulverulenta	Lot 1002	1.6	3.8	2.7	62	41	52
8	L. pulverulenta	Lot 0999	1.2	3.3	2.2	55	56	56
31	L. pulverulenta	Lot 1001	2.0	2.4	2.2	61	47	54
28	L. retusa	Junctron	0.3	1.1	0.7	60	31	46
25	L. retusa	Balmorhea	0.1	1.2	0.7	48	27	38

Table 4 Leaflet yield of *Leucaena* species harvested at two frequencies, 1983

Source ID	Species	PI or source	Leaf and succulent		
			stems DM yield		avg
			4-wk	8-wk	
			-----tons/acre-----		
5	L. leucocephala	K123 UH	2.4	4.1	3.3
18	L. leucocephala	Pinaciaba	2.4	4.5	3.5
3	L. leucocephala	281607	2.4	3.9	3.2
15	L. leucocephala	78-10 Salvador	2.3	3.4	2.9
7	L. leucocephala	Univ. Fla.	2.4	3.3	2.9
6	L. leucocephala	N. E. Brazil	2.6	2.8	2.7
11	L. leucocephala	K-72 UH	2.2	2.6	2.4
23	L. leucocephala	K-8 Salvador	2.0	2.9	2.5
16	L. leucocephala	78-15 Salvador	2.1	2.5	2.3
12	L. leucocephala	Campina grande	2.4	2.1	2.3
26	L. leucocephala	Colombia	1.6	2.4	2.0
1	L. leucocephala	443614	2.1	2.6	2.4
10	L. leucocephala	31797	1.7	2.3	2.0
30	L. leucocephala	Belem	2.0	2.1	2.1
27	L. leucocephala	8-5- Taxtia	2.0	2.3	2.2
21	L. leucocephala	4157031.8	1.8	2.9	2.4
24	L. leucocephala	K341 Hawaii	2.4	1.4	1.9
34	L. leucocephala	K4 UH	1.9	2.2	2.1
13	L. leucocephala	322552	1.5	1.9	1.7
4	L. leucocephala	414742	1.8	1.7	1.8
2	L. leucocephala	78-24c	1.8	1.8	1.8
33	L. leucocephala	304650	1.4	2.1	1.8
35	L. leucocephala	78-30 Yucatan	1.5	1.9	1.7
22	L. leucocephala	288004	1.2	1.7	1.5
36	L. leucocephala	78-19 Belize	1.7	1.3	1.4
20	L. leucocephala	78-15 Colombia	1.5	1.6	1.6
9	L. leucocephala	281784	1.1	1.8	1.5

Table 4 Leaflet yield of *Leucaena* species harvested at two frequencies, 1983 (Continued)

Source ID	Species	PI or source	Leaf and succulent		
			stems DM yield		avg
			4-wk	8-wk	
			-----tons/acre-----		
19	L. leucocephala	78-11 Salvador	1.9	.7	1.3
17	L. pulverulenta	AJ03279	2.3	1.2	1.8
14	L. pulverulenta	Lot 1000	1.5	1.8	1.7
29	L. pulverulenta	K340	1.4	1.8	1.6
32	L. pulverulenta	Lot 1002	1.0	1.7	1.4
8	L. pulverulenta	Lot 0999	.7	1.8	1.3
31	L. pulverulenta	Lot 1001	1.2	1.1	1.2
28	L. retusa	Juncron	.2	.3	.3
25	L. retusa	Balmorhea	.1	.2	.2

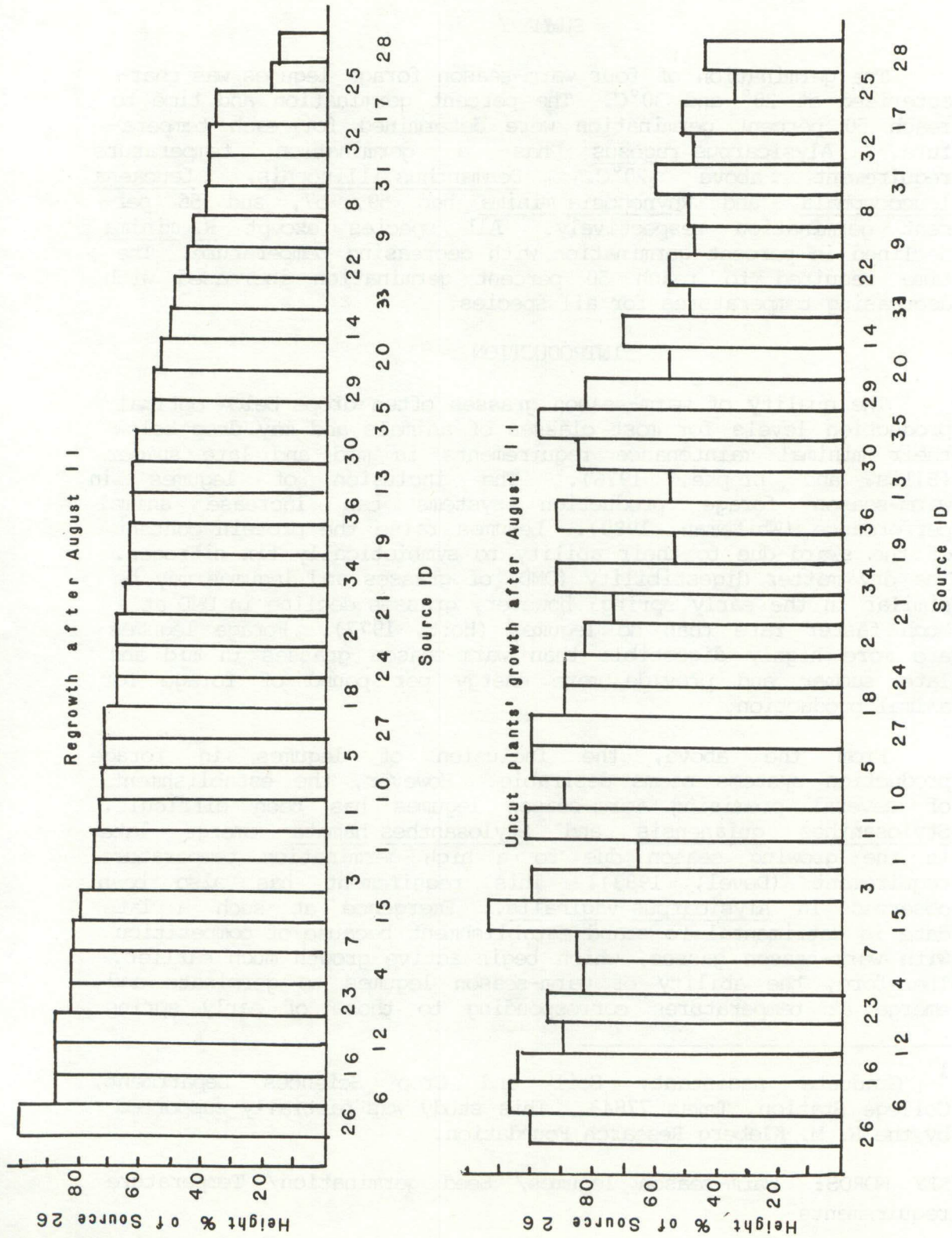


Figure 1. Relative growth and regrowth of *Leucaena* sources in 1983.