

Performance and Chemical Composition of 18 Nondormant Alfalfa Cultivars at the Lajas Valley¹

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ABSTRACT

Eighteen alfalfa (*Medicago sativa*) cultivars were evaluated as to dry forage and crude protein yields at the Lajas Research and Development Center; there were 6 cuttings during a 232-day period. Dry forage yields ranged from 4,673 kg/ha for Tanverde (lowest) to 11,675 kg/ha for Maracay (highest) cultivar. Good yields were also obtained with Florida 66, Moapa, Peruvian, Certified Mesa Sirsa, and Hayden PX-1 cultivars. Stand persistence declined markedly after the fifth harvest due to *Phytophthora* root rot infestation. Maracay, Florida 66, and Certified Mesa Sirsa showed the best persistence through the sixth cutting. Mean overall values for neutral-detergent fiber, acid-detergent fiber, lignin, cellulose, silica, crude protein, phosphorus, and potassium contents for the 18 cultivars were 34.86, 29.13, 10.22, 17.08, 1.42, 21.86, 0.36, and 2.08%, respectively. Insects were not a major problem in this study.

INTRODUCTION

Because of the outstanding nutritional properties of alfalfa (*Medicago sativa*), there is great interest in the introduction and evaluation of new cultivars of this forage for use on the southern coast of Puerto Rico. In the form of pellets or hay, alfalfa would be very useful as a feed ingredient in horse, rabbit, and poultry rations. Also, appealing is associating alfalfa with tropical grasses to increase forage yield and nutritive value during the cool months.

Freyre et al. (2), in 1954, compared the yields of 15 alfalfa cultivars at the Lajas Agricultural Experiment Substation. Among the best dry forage (DF) yielders in four harvest were Peruvian, Uruguay 10, and Arizona-Chilean, with 12344, 12061, and 12053 kg/ha, respectively. They also reported a lack of stand persistence after the fifth harvest because of root rot caused by unidentified organism. In Arizona, Hine et al. (5) reported that this disease, caused by the fungus *Phytophthora megasperma*, was an important factor in yield decline. A recent preliminary screening trial with 25 nondormant cultivars at the Corozal Agricultural Experiment Substation demonstrated that the best cultivars were Florida 66, Mesa Sirsa LB-1, and Hayden PX-1 (11).

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The objective of the present study was to determine the adaptability of various alfalfa varieties to conditions on the southern coast of Puerto Rico in terms of forage yields and chemical composition.

MATERIALS AND METHODS

The trial was conducted at the Lajas Research and Development Center during a 232-day period from January 31, 1978 to September 20, 1978, and involved 18 alfalfa cultivars (table 1). After the initial cutting, these were harvested every 30 days at the 25% bloom stage on six different occasions.

The soil was a Fraternidad clay (Vertisol), the top 20 cm layer of which contained 12.5 p/m of phosphorus (P), 194 p/m of potassium (K), and gave a pH reading of approximately 6.3 (7).

The experimental layout was a partially-balanced incomplete block design with four replicates. Individual plots were 213.36 cm wide \times 487.68 cm long and consisted of seven plant rows 30.48 cm apart. Green forage (GF) yields were obtained from the five-center rows only.

Alfalfa seeds were inoculated with *Rhizobium meliloti*, immediately before hand planting. Aerial irrigation was applied on the following dates: February 1 and 16; March 1, 18, and 23; April 24 and 28; May 20 and 31; June 30; July 7 and 31; August 5 and 7; and September 18. Three hand weedings of the experimental plots were necessary. The only fertilizer used during the course of the experiment was borax, which was applied 4 mo after planting at a rate of 5.6 kg/ha, because of deficiency symptoms of this mineral.

All cultivars were harvested at a height of approximately 3 cm from the ground with a Gravely³ sickle bar machine, and the forage was immediately weighed. Plot samples were taken, dried at 60° C, and ground in a Wiley mill to pass through a 1-mm screen.

Dry matter (DM) content was determined in all samples. For each harvest, samples were composited by replications and each cultivar was subjected to sulphuric acid digestion (8), N, P, and K prior to determination with a Technicon auto analyzer. Crude protein was calculated as $N \times 6.25$. Representative samples from each cultivar were analyzed for neutral-detergent fiber (NDF), acid-detergent fiber (ADF), lignin (L), cellulose (C), and silica (Si) (3). Neutral-detergent soluble (NDS) content was calculated as the difference between 100 and NDF; and hemicellulose (H) content as the difference between NDF and ADF.

³ Research Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

TABLE 1.—*Identification of 18 alfalfa cultivars*

Cultivar	Seed Source
Maracay	FAO-United Nations Development Program, Santo Domingo, Dominican Republic
Florida 66	Agronomy Department, Univ. of Florida, Gainesville, Florida 32611
Certified Mesa Sirsa	Plant Sciences Department, Univ. of Arizona, Tucson, Arizona 85721
Moapa	FAO-United Nations Development Program, Santo Domingo, Dominican Republic
Hayden PX-1	Plant Sciences Department, Univ. of Arizona, Tucson, Arizona 85721
Peruvian	FAO-United Nations Development Program, Santo Domingo, Dominican Republic
UC-76-E	Agric. Sciences Division, Imperial Valley Field Station, Univ. of California, El Centro, California 92243
Sonora-70	Plant Sciences Department, Univ. of Arizona, Tucson, Arizona 85721
Certified Hayden	Plant Sciences Department, Univ. of Arizona, Tucson, Arizona 85721
AZ Mexon (scald tol.)	Plant Sciences Department, Univ. of Arizona, Tucson, Arizona 85721
Mesa Sirsa Lateral Branch	Plant Sciences Department, Univ. of Arizona, Tucson, Arizona 85721
UC-Salton	Agric. Sciences Division, Imperial Valley Field Station, Univ. of California, El Centro, California 92243
UC-Cargo	Agric. Sciences Division, Imperial Valley Field Station, Univ. of California, El Centro, California 92243
CUF-101	Agric. Sciences Division, Imperial Valley Field Station, Univ. of California, El Centro, California 92243
WL-311	Penington Seed, Inc., P. O. Box 290, Madison, Georgia 30650
Liberty (NCW-20)	USDA ARS Southern Region, North Carolina State Univ., Raleigh, North Carolina 27607
Thor	Northrup King Co., P. O. Box 959, Minneapolis, Minnesota 55440
Tanverde	USDA Regional Plant Introduction Station, Experiment, Georgia 30212

Means for GF and DF yields and DM content were compared by Duncan's (1) multiple range test (10).

RESULTS AND DISCUSSION

The monthly rainfall pattern during the 232-day period was as follows: 55.9 mm (February); 106.9 mm (March); 82.5 mm (April); 25.4 mm (May); 25.0 mm (June); 59.2 mm (July); 278.3 mm (August); and 9.4 mm (September 1–20), for a total of 642.6 mm. The August rainfall repre-

sented 43.3% of the total. The 15 aerial irrigations were equivalent to 190 mm.

Uniform stands were obtained initially for all cultivars except for Tanverde. Tanverde stands in each replicate were approximately 75% as heavily populated as the rest of the cultivars.

Table 2 shows the total GF, DF, and CP yields and DM content. The highest GF yielders were Maracay, Florida 66, and Certified Mesa Sirsa cultivars, while the lowest were WL-311, Liberty (NCW-20), Thor, and

TABLE 2.—Total green forage, dry forage and crude protein yields and mean dry matter content of 18 alfalfa cultivars during a 232-day period

Cultivar	Green forage yield	Dry matter content	Dry forage yield	Crude protein yield
	kg/ha	%	kg/ha	kg/ha
Maracay	45,063 a ¹	25.87 d	11,675 a	2,452
Florida-66	40,202 ab	27.96 ad	11,231 ab	2,583
Certified Mesa Sirsa	38,709 ac	26.49 cd	10,277 ac	2,261
Moapa	34,431 bc	28.15 ad	9,454 ad	2,080
Hayden PX-1	34,392 bc	26.42 cd	8,976 bd	1,974
Peruvian	34,294 bc	26.96 cd	9,099 bd	2,002
UC-76-E	31,894 bd	27.02 cd	8,357 ce	1,839
Sonora-70	31,584 bd	28.02 ad	8,710 cd	1,916
Certified Hayden	31,270 bd	27.17 bd	8,477 ce	1,865
AZ Mexon (scald tol.)	30,774 be	28.46 ac	8,495 ce	1,776
Mesa Sirsa Lateral Branch	30,665 be	26.23 cd	7,908 cf	1,661
UC-Salton	30,367 ce	27.69 ad	8,273 ce	1,820
UC-Cargo	30,186 ce	27.95 ad	7,988 cf	1,677
CUF-101	29,858 ce	27.65 ad	8,068 cf	1,775
WL-311	24,718 df	28.65 ac	6,978 df	1,675
Liberty (NCW-20)	22,772 df	29.84 a	6,209 dg	1,428
Thor	21,631 ef	28.38 ac	5,733 fg	1,374
Tanverde	16,523 f	29.66 ab	4,673 g	1,028
Mean	31,074	27.70	8,366	1,844

¹ Values in the same column followed by one or more letters in common do not differ significantly at the 5% probability level.

Tanverde. GF yields varied from a maximum of 45,063 for Maracay cultivar to a minimum of 16,523 kg/ha for Tanverde cultivar.

The two variables GF yield and DM content were inversely related. The lowest GF yielder (Tanverde) presented the second highest DM content, while the highest GF yielder (Maracay) had the lowest DM content. Nevertheless, Maracay outyielded all other cultivars in DF, followed by Florida 66, Certified Mesa Sirsa, Moapa, Peruvian, and Hayden PX-1 in the same order as for GF yield, except for Peruvian and

Hayden PX-1 cultivars. Maracay produced 4, 14, and 23% more DF than Florida 66, Certified Mesa Sirsa, and Moapa, respectively. Lowest DF yielders were Liberty (NCW-20), Thor, and Tanverde cultivars. In variety trials in the Dominican Republic (4) and Texas (6), Florida 66 was the top yielder. According to Ruelke (9), Florida 66 outyielded all other cultivars tested in Florida up to 1971.

The best DF yielders (Maracay, Florida 66, Certified Mesa Sirsa, Moapa, Peruvian, and Hayden PX-1) were also the best CP yielders, although Florida 66 replaced Venezuela at the top. CP yields ranged from 2,583 for Florida 66 to 1,028 kg/ha for Tanverde.

Table 3 shows the data on DF yields per harvest. DF yields diminished at each successive harvest up to the sixth, because of a severe infestation of *Phytophthora* root rot. Similar yield reductions in different cultivars due to *Phytophthora* root rot were reported previously at the Lajas Valley by Freyre et al. (2). In the present study, it was observed that Maracay, Florida 66, and Certified Mesa Sirsa plots were the least affected by this disease; thus, these cultivars are more resistant to *Phytophthora* root rot.

Table 4 shows the mean results from the chemical analyses of the 18 cultivars. In general, a considerable degree of uniformity in chemical composition is noted among the different cultivars. A slight tendency can be observed for higher yielding cultivars to exhibit lower CP content and higher NDF content, although Florida 66 does not conform to this pattern. Table 5 shows simple correlation coefficients among the chemical constituents. As NDS and CP contents increased, NDF, ADF, H, and C contents decreased ($P = .01$). Contrary to expectations, Si content tended to decrease with an increase in the fibrous constituents: NDF ($P = .05$) and C ($P = .01$). P content also decreased with an increase in C content ($P = .05$) (table 5).

These results suggest that alfalfa production is feasible on the southern coast of Puerto Rico. However, in spite of being a perennial crop, alfalfa performs as an annual under most humid tropical conditions. As a result, alfalfa management is more complicated and laborious than grass management. Further research is needed to determine whether alfalfa cultivation for hay production is economical in Puerto Rico.

RESUMEN

Se realizó un estudio de 18 cultivares de alfalfa (*Medicago sativa*) en el Centro de Investigación y Desarrollo de Lajas para evaluar la aptitud y la producción en un período de 232 días (seis cortes del 31 de enero al 20 de septiembre de 1978). Los rendimientos de forraje seco variaron de 4,673 kg/ha (Tanverde—más bajo) a 11,675 kg/ha Maracay—más alto). Se determinó además que las mejores cultivares en rendimiento y persis-

TABLE 3.—*Dry forage yields of 18 alfalfa cultivars at 6 harvest dates over a 232-day period*

Cultivar	Harvest dates ¹						Total
	April 18	May 18	June 19	July 13	August 17	September 20	
	<i>kg/ha</i>						
Maracay	2,993	1,988	2,170	1,586	1,732	1,206	11,675
Florida-66	3,338	1,589	2,114	1,434	1,888	868	11,231
Certified Mesa Sirsa	2,719	1,608	1,721	1,298	1,202	1,729	10,277
Moapa	3,167	1,650	2,027	1,533	1,077	—	9,454
Hayden PX-1	2,836	1,607	1,814	1,302	980	437	8,976
Peruvian	3,021	1,782	1,966	1,229	946	155	9,099
UC-76-E	2,469	1,820	1,870	1,273	868	57 ²	8,357
Sonora-70	2,716	1,317	1,731	1,316	968	662	8,710
Certified Hayden	2,948	1,416	1,686	1,035	884	508	8,477
AZ Mexon (scald tol.)	2,702	1,586	1,877	1,114	755	461	8,495
Mesa Sirsa							
Lateral Branch	2,252	1,289	1,447	981	734	401 ²	7,908
UC-Salton	2,971	1,600	1,651	1,077	533	441	8,273
UC-Cargo	2,668	1,486	1,553	922	789	570 ²	7,988
CUF-101	3,260	1,607	1,723	1,074	404	—	8,068
WL-311	3,071	1,445	1,556	745	161	—	6,978
Liberty (NCW-20)	2,691	1,347	1,276	718	177	—	6,209
Thor	2,394	1,074	1,116	690	274	185 ³	5,733
Tanverde	968	700	1,021	671	586	727 ²	4,673
Mean	2,732	1,495	1,684	1,111	831	467	8,366

¹ Each yield is a mean of 4 replicates.² Mean of 3 replicates.³ Mean of 2 replicates.

TABLE 4.—Mean chemical and mineral composition of 18 alfalfa cultivars during a 232-day period

Cultivar	NDF ¹	NDS	ADF	H	L	C	Si	CP	P	K
	%									
Maracay	35.37	64.63	30.13	5.24	9.87	18.90	.93	21.38	.33	2.04
Florida-66	33.37	66.63	28.60	4.77	9.43	16.64	1.68	22.81	.34	2.05
Certified Mesa Sirsa	36.14	63.86	28.73	7.41	10.05	17.31	1.14	21.50	.35	2.01
Moapa	34.49	65.51	28.84	5.65	9.10	18.17	1.12	21.50	.34	2.18
Hayden PX-1	34.91	65.09	29.71	5.20	10.03	18.08	1.00	20.50	.36	2.24
Peruvian	35.21	64.79	29.06	6.15	10.95	16.71	.98	21.88	.38	2.14
UC-76-E	34.22	65.78	28.63	5.59	10.00	16.82	1.66	21.75	.35	1.92
Sonora-70	36.18	63.82	29.69	6.49	10.33	17.63	1.38	21.50	.36	1.92
Certified Hayden	35.31	64.69	29.22	6.09	10.07	17.60	.84	21.81	.35	2.14
AZ Mexon (scald tol.)	36.70	63.30	31.08	5.62	12.46	17.03	1.31	21.13	.36	2.16
Mesa Sirsa										
Lateral Branch	36.85	63.15	30.34	6.51	10.36	18.06	1.30	20.88	.36	1.90
UC-Salton	34.78	65.22	29.00	5.78	10.46	17.12	1.40	21.69	.37	2.17
UC-Cargo	35.80	64.20	29.65	6.15	10.28	17.28	1.85	21.25	.36	2.12
CUF-101	35.50	64.50	29.83	5.67	10.75	17.61	1.34	21.81	.35	2.00
WL-301	33.74	66.26	28.88	4.86	10.39	15.92	2.35	23.50	.37	2.07
Liberty (NCW-20)	32.53	67.47	27.29	5.24	9.18	15.90	1.48	23.31	.37	2.05
Thor	30.76	69.24	26.73	4.03	10.20	13.76	2.06	23.56	.37	2.17
Tanverde	35.54	64.46	28.96	6.58	10.04	16.90	1.70	21.75	.35	2.12
Mean	34.86	65.14	29.13	5.73	10.22	17.08	1.42	21.86	.36	2.08

¹ NDF, neutral-detergent fiber; NDS, neutral-detergent solubles; ADF, acid-detergent fiber; H, hemicellulose; L, lignin; C, cellulose; Si, silica; CP, crude protein; P, phosphorus; K, potassium.

TABLE 5.—Simple correlations among constituents of 18 alfalfa cultivars

Constituent	NDF	NDS	ADF	H	L	C	Si	CP	P	K
DM ¹	-.41	.41	-.43	-.23	-.06	-.56* ²	.57*	.58*	.28	.20
NDF		-1.00** ³	.88**	.79**	.45	.77**	-.50*	-.82**	-.22	-.25
NDS			-.88**	-.79**	-.45	-.77**	.50*	.82**	.22	.25
ADF				.40	.57*	.75**	-.42	-.78**	-.26	-.12
H					.13	.51*	-.42	-.59**	-.08	-.33
L						-.04	-.02	-.27	.37	.09
C							-.70**	-.82**	-.57*	-.17
Si								.64**	.30	-.10
CP									.29	.00
P										.20

¹ DM, dry matter; NDF, neutral-detergent fiber; NDS, neutral-detergent solubles; ADF, acid-detergent fiber; H, hemicellulose; L, lignin; C, cellulose; Si, silica; CP, crude protein; P, phosphorus; K, potassium.

² Significant at the 5-percent level.

³ Significant at the 1-percent level.

tencia fueron Florida 66, Moapa, Certified Mesa Sirsa, Peruvian y Hayden PX-1. Debido principalmente a la alta incidencia de la pudrición de la corona, causada por el hongo *Phytophthora*, el rendimiento de forraje seco bajó notablemente después del quinto corte en toda las cultivares, excepto en Maracay, Florida 66 y Certified Mesa Sirsa. Los promedios globales de fibra neutrodetergente, fibra ácidodetergente, lignina, celulosa, sílice, proteína bruta, fósforo y potasio en las 18 cultivares fueron 34.86, 29.13, 10.22, 17.08, 1.42, 21.86, .36 y 2.08%, respectivamente. Los insectos no causaron gran daño en este estudio.

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