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Bahamas Agricultural Research Training And Development Project

PERFORMANCE OF FIVE ALFALFA VARIETIES

A.E. & R.S. BAHAMAS
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Performance of Five Alfalfa Varieties on North Andros Island, Bahamas

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Alfalfa (Medicago sativa) is a widely adapted, deep rooted, erect perennial legume grown for both pasture and hay in temperate, sub-tropical and tropical regions of the world. An extremely drought tolerant plant, it is also much more frost tolerant than tropical legumes. It is best adapted to neutral or alkaline soils that are well drained and fertile and is known to have a high demand for plant nutrients, especially phosphate and potash.

Prior to the initiation of the BARTAD Project there was no history of growing alfalfa on the limestone derived soils of the Bahamas. However, because of its deep root system and the presence of water at a 4-5 foot depth Penn State Scientists felt this species might have potential as a productive, high protein pasture and hay legume for both cattle and sheep on Andros Island.

Soils and Weather

Soils at the BARTAD Site are composed of oolitic limestone sediments formed during the Pliestocene Era. Solution of the limestone by rain and sea water during the ice age resulted in the typical flat topography containing numerous sink holes and solution channels. The water table at the experimental site is approximately 4 feet below the soil surface.

The pH values of the soils on site range from 7.8 to 8.2. Typically for the site soil P levels are very low, K levels are low to medium, calcium levels are very high and magnesium levels medium. Typical soil levels of several other elements are: aluminum .20 ppm (very low), manganese 3.00 ppm (very low), iron 10.00 ppm (low), copper 14.00 ppm (normal), zinc less than 20.00 ppm (low) and sodium less than 50.00 ppm (normal).

Rainfall and temperature data for the period of the study taken from official BARTAD records are given in Table 1. Precipitation at the site is approximately 46-52 inches annually with the dry season beginning in December and ending in May. However, as indicated in Table 1, seasonal rainfall from year to year may be highly variable and has a marked influence on total and seasonal crop production.

Materials and Methods

Varieties:

Varieties used in this trial were chosen in consultation with Dr. M. H. Schonhorst, alfalfa breeder, University of Arizona, based on known characteristics of the varieties, varietal performance in southwestern U.S.A. and seed availability. Inasmuch as there was no history of alfalfa production in the Bahamas, and facilities for conducting research trials were limited, it was agreed to limit the number of entries in this initial study to the following five non-winter dormant varieties.

Mesa-Sirsa developed by the Arizona Agricultural Experiment Station and the Entomology Research Division of the USDA, was officially released in 1966. Under Arizona conditions Mesa-Sirsa is superior to Moapa and Sonora in forage production and resistance to most biotypes of the spotted alfalfa aphid (SAA), a serious insect pest in Western U.S.A. It has been a popular variety in Southern Arizona and seed is readily available. Mesa-Sirsa has a low level of resistance to the most recent biotype, H, of the spotted alfalfa aphid.

Sonora-70 was developed by the Arizona Agricultural Experiment Station and the U.S.D.A. and resulted from plant selections from the older variety Sonora. It was officially released in 1970. In tests conducted by personnel of the University of Arizona and the U.S.D.A., Sonora-70 was superior to Moapa and Sonora in forage production, resistance to the spotted alfalfa aphid and in stand persistence. Observations in California indicated that Sonora-70 has had less injury caused by feeding of the Egyptian alfalfa weevil than most non-dormant varieties. When grown on well drained, light to medium textured soils in Arizona, Sonora-70 has produced slightly more forage than Mesa-Sirsa. It is highly susceptible to stem nematodes and is susceptible to newer biotypes of SAA, so would not perform satisfactorily in the presence of these pests.

Hayden was developed by the Arizona Agricultural Experiment Station and the U.S.D.A. and released in 1970. In tests on the University of Arizona Mesa Branch Experiment Farm it was similar to Mesa-Sirsa in resistance to SAA and superior to Mesa-Sirsa and Sonora-70 in resistance to the stem nematode and in stand persistence. Hayden alfalfa plants have finer stems than those of Mesa-Sirsa. This characteristic speeds drying after cutting and helps to reduce the risk of rain damage.

Mex-Son was developed by the Arizona Experiment Station and resulted from plant selections from a farmer's field of Sonora alfalfa near Navajoa in the State of Sonora, Mexico. Clones were selected based on resistance or freedom from symptoms of Stemphylium botryosium. Mex-Son has a good level of resistance to several biotypes of pea aphid but a relatively low level of resistance to newer biotypes of SAA.

Mex-Son R is similar to Mex-Son but has resistance to the newer biotypes of spotted alfalfa aphid.

Land Preparation:

The area in which the experiment was established was rough cleared in the fall of 1973, disked several times with the D-8 tractor and Rome disk and then rolled several times with a grid roller.

Prior to seeding in 1974 larger rocks were removed by hand, the area was redisked with a small disk, cultipacked and prepared for seeding.

Table 1. Average temperature and rainfall data by months, May 1974 - December 1976 (BARTAD)

	1974				1975				1976			
	Rainfall inches	Temperature F° Avg.	Min.	Max.	Rainfall inches	Temperature F° Avg.	Min.	Max.	Rainfall inches	Temperature F° Avg.	Min.	Max.
January	---	---	---	---	4.43	70	51	84	.55	64	42	80
February	---	---	---	---	3.65	70	55	86	3.95	66	44	84
March	---	---	---	---	1.42	69	47	88	.16	72	50	86
April	1.72	---	---	---	.69	73	51	89	1.41	73	52	87
May	2.87	75	55	91	5.63	75	59	90	6.85	77	62	89
June	8.00	79	63	91	6.75	78	63	91	14.35	76	62	86
July	6.17	79	70	88	5.19	79	66	90	.89	79	67	94
August	6.93	79	68	91	2.33	80	63	91	4.30	79	66	92
September	5.68	80	68	91	5.39	80	68	89	7.48	78	64	91
October	5.84	76	61	88	4.41	78	60	88	7.93	76	56	90
November	3.11	71	51	84	6.44	74	50	85	3.78	74	55	91
December	.47	66	45	84	1.80	68	48	83	2.23	70	42	85
Total	40.79				48.43				53.88			

Fertilization:

The overall fertility program was based on soil samples taken at the time the project was initiated. A total of 2125 pounds/A of an 8-18-8 special mix fertilizer containing micronutrients was broadcast by hand and disked in to a depth of approximately 3" prior to seeding. Sources of the primary plant foods in the fertilizer were sulfate of ammonia, mono-ammonium phosphate, sulfate-potash-magnesium, and ammonium nitrate. Amounts and sources of secondary plant foods were: MgO 6.75% (sulfate-potash-magnesium), manganese MnO 1.70% (mangenses frit), boron B_2O_3 .28% (borax), copper CuO .93% (copper sulfate) and zinc ZnO 1.9% (zinc sulfate).

Forty pounds per acre of K_2O from sulfate-potash-magnesium was broadcast after each harvest (400 pounds K_2O per year) while 100 pounds per acre of P_2O_5 from super phosphate was applied annually.

Establishment:

Following fertilization and disking the plot area was cultipacked. Individual 6 x 12 foot plots were broadcast seeded by hand on August 9, 1974 at a rate of 20 pounds per acre using a randomized block design with four replications, and then cultipacked and irrigated. To assure adequate moisture for germination and early emergence, plots were irrigated frequently during the first five weeks after planting.

Harvest Methods:

The first 12 harvests were made using a Gravely sickle bar walking mower. Plots harvested for yield were 39" wide by 9' long. The total sample was weighed and a subsample taken for moisture determination.

Harvests 13 through 20 were made using a Carter self-propelled flail harvester 36" wide. All other procedures were the same for all harvests.

Moisture samples were dried in a fuel-oil heated forced air dryer at 135°F for seven days. After weighing, the dry subsamples were composited across replications and ground with a Wiley mill through a 1 mm screen. Ground samples were analyzed for crude protein and IVDMD (in vitro dry matter disappearance) at The Pennsylvania State University. Composited samples for four harvests that had been saved for grinding and analysis were destroyed in a dryer fire.

Results and Discussion

Dry Matter Yields:

Dry matter yields by cuttings for the five varieties by approximately twelve month periods are presented in Table 2 & 3. Total production for the two years are summarized in Table 4. As indicated the first harvest was made October

Table 2. Dry Matter Yields of Five Alfalfa Varieties in Tons Per Acre for the First Approximate 12 Months of Harvest

	Harvest Date										
Vareity	10/17/74	11/25/74	2/20/75	4/2/75	5/2/75	6/6/75	7/4/75	8/7/75	9/15/75	10/21/75	Total
	DM Tons/A										
Mex-Son R	.51	.69	1.49	1.60	1.00	.85	.51	.59	.60	.89	8.73
Mesa-Sirsa	.61	.65	1.49	1.66	.67	.77	.42	.67	.63	1.00	8.57
Sonora-70	.46	.72	1.51	1.22	.60	.87	.43	.54	.58	.91	7.84
Hayden	.55	.78	1.40	1.64	.67	.75	.43	.48	.57	.96	8.23
Mex-Son	.60	.70	1.43	1.34	.75	.92	.49	.47	.51	.88	8.09
L.S.D. 05	.26	.24	.37	.68	.26	.22	.11	.17	.10	.23	1.50

Table 3. Dry Matter Yields of Five Alfalfa Varieties in Tons Per Acre for the Second Approximate 12 Months of Harvest

Variety	Harvest Date										
	12/2/75	1/19/76	3/4/76	4/1/76	5/4/76	5/27/76	7/1/76	8/10/76	8/16/76	10/27/76	Total
	DM Tons/A										
Mex-Son R	.80	.75	.81	1.53	1.20	1.08	.65	.73	.86	.84	9.25
Mesa-Sirsa	1.05	.77	.75	1.03	1.03	1.08	.57	.69	.80	.94	8.71
Sonora-70	.84	.81	.94	1.25	1.15	1.13	.53	.73	.89	.63	8.90
Hayden	.93	.75	.73	1.07	.93	.82	.59	.71	.82	.92	8.27
Mex-Son	.76	.74	.70	1.17	1.11	1.11	.56	.66	.77	.77	8.35
L.S.D. .05	.19	.15	.17	.10	.17	.19	.09	.17	.17	.25	.74

Table 4. Two-Year Total Dry Matter Yields and Average Annual Yields of Five Alfalfa Varieties in Tons Per Acre

Variety	1st. Year	2nd Year	Two-Year Total	Ave/Yr.
	DM T/A			
Mex-Son R	8.73	9.25	17.98	8.99
Mesa-Sirsa	8.57	8.71	17.28	8.64
Sonora-70	7.84	8.90	16.74	8.37
Hayden	8.23	8.27	16.50	8.25
Mex-Son	8.09	8.35	16.44	8.22
L.S.D. .05	1.50	.74	1.96	

17, 1974, 69 days after seeding. Cutting intervals during the two-year period ranged from a minimum of 23 days to a maximum of 87 days depending on rainfall, temperature, daylength and other factors.

Total dry matter yields for the two-year period (20 harvests) ranged from 16.44 tons/A to 17.98 tons/A. There were no significant differences in yield among the five varieties. Except for Sonora-70 yield differences for each twelve-month period for each variety were minor.

Forage Quality:

Crude protein and IVDMD percentages by varieties for sixteen of the twenty harvests are listed in Tables 5 & 6. While values for both factors varied from variety to variety, both within and between cuttings, there was no evidence of any consistent differences among varieties in either crude protein or IVDMD.

Quality in terms of both crude protein and IVDMD is closely related to the stage of maturity at the time of harvest and may be modified by the presence of either insects or diseases or both. The amount of bloom is one estimate of maturity. Estimates of percent bloom at the time of harvest were made for all but two cuttings and are reported in Table 7. Values given are the average of four replications for each variety at each cutting.

Insect and Disease Problems

The following insects have been observed damaging both alfalfa plots and field stands at the BARTAD site: fall armyworm, *Spodoptera tragiperda*; yellowstriped armyworm, *Spodoptera ornithogalli*; southern armyworm, granulate cutworm, *Feltia subterranea*; saltmarsh caterpillar, *Estigmene acrea*, and a webworm of possible *Loxostege* species.

The most damaging of the insects appear to be the armyworms and webworms. These insects have caused severe problems in new seedings of alfalfa which were planted during the period of May through early July. Cygon (dimethoate) sprayed at the rate of 1 1/2 pints per acre gave adequate control of these insects if applied before damage became too severe. Webworms attacked established alfalfa stands, but if the alfalfa was grazed or harvested for hay it recovered without spraying.

Several diseases including Alfalfa Rust, *Uromyces striatus*, var. *medicaginis*, and Stemphylium Leafspot, *Stemphylium botryosum*, have been observed in alfalfa plots and in field stands at the BARTAD site. Alfalfa Rust was observed during the period of January-February and disappeared after stands were clipped. Stemphylium Leafspot was observed on both research plots and field stands from February until June. Damage ranged from very light to very severe with nearly 100% of the leaves turning yellow. Mex-Son, Mex-Son R and Sonora 70 appeared to be somewhat less susceptable than Hayden or Mesa-Sirsa.

Table 5. Crude Protein Percentages of Five Alfalfa Varieties Over 16 Harvests.

Variety	Harvest Date 10/17/74	11/25/74	2/20/75	5/2/75	6/6/75	8/7/75	9/15/75	10/21/75
	%CP							
Mex-Son R	18.90	20.59	17.63	16.32	17.51	20.00	20.31	19.44
Mex-Son	16.92	19.22	16.41	19.62	18.13	19.30	20.55	18.09
Mesa-Sirsa	19.54	19.37	20.19	20.64	20.18	20.55	19.17	19.77
Hayden	18.30	20.23	16.51	18.62	18.63	20.09	20.99	19.44
Sonora-70	15.97	19.26	17.92	18.26	18.26	19.02	20.17	---(1)
Ave. Per Cut	17.93	19.73	17.73	18.69	18.54	19.79	20.24	19.18

(1) Missing sample

Variety	Harvest Date 12/2/75	1/19/76	3/4/76	4/1/76	7/1/76	8/10/76	9/16/76	10/27/76	Average All Harvests
	%CP								
Mex-Son R	18.62	18.27	19.49	19.89	17.90	16.39	14.30	12.30	17.99
Mex-Son	18.11	20.30	18.79	19.57	16.40	15.83	15.88	13.30	17.90
Mesa Sirsa	19.00	17.75	16.69	19.91	16.36	18.48	16.75	14.92	18.89
Hayden	19.48	18.24	20.00	21.37	16.03	17.39	16.45	14.66	18.53
Sonora-70	18.64	18.21	19.14	20.05	15.27	16.10	15.39	14.30	17.73
Ave. Per Cut	18.77	18.55	19.42	20.16	16.39	16.84	15.75	13.90	

Table 6. IVDMD Percentages of Five Alfalfa Varieties Over Sixteen Harvests

Variety	Harvest Date 10/17/74	11/25/74	2/20/75	5/2/75	6/6/75	8/7/75	9/15/75	10/21/75
	% IVDMD							
Mex-Son R	64.62	73.84	64.96	63.52	62.12	64.29	64.66	65.17
Mex-Son	61.68	73.11	63.19	65.59	63.97	63.52	64.64	62.57
Mesa-Sirsa	64.77	71.61	62.65	63.89	64.23	64.04	60.03	64.47
Hayden	63.44	72.41	61.73	59.64	63.81	64.21	64.62	64.16
Sonora-70	61.64	72.47	64.01	62.64	63.12	62.87	63.84	--(1)
Ave. Per Cut	63.23	72.69	63.31	63.06	63.45	63.79	63.56	64.09

Variety	Harvest Date 12/2/75	1/19/76	3/4/76	4/1/76	7/1/76	8/10/76	9/16/76	10/27/76	Average All Harvests
	% IVDMD								
Mex-Son R	69.46	66.35	62.40	64.74	60.43	58.81	55.96	58.86	63.76
Mex-Son	69.56	67.46	59.15	65.02	60.13	58.11	58.16	60.66	63.54
Mesa-Sirsa	67.69	64.60	58.73	61.86	58.80	59.97	57.92	61.52	62.92
Hayden	68.84	66.63	56.92	65.51	55.26	60.31	58.71	63.57	63.11
Sonora-70	69.11	67.33	59.35	66.49	56.59	57.36	58.06	61.85	63.11
Ave. Per Cut	68.93	66.47	59.31	64.72	58.24	58.91	57.76	61.28	

(1) Missing sample

Table 7. Estimated Percent Bloom at Time of Each Cutting for Five Alfalfa Varieties
(Average of Four Replications)

	1974								1975								1976			
	% Bloom																			
	10/17	11/25	2/20	4/2	5/2	6/6	7/4	8/7	9/15	10/21	12/2	1/19	3/4	4/1	5/4	5/27	7/1	8/10	9/16	10/2
Mex-Son R	50	15	50	67	60	77	36	60	76	Missing	50	35	14	Missing	32	50	10	36	67	98
Mex-Son	50	30	20	77	51	79	40	70	81		42	41	11		35	50	11	75	69	98
Mesa-Sirsa	50	15	50	77	27	60	25	56	54		40	51	11		27	17	7	51	40	92
Hayden	50	15	50	80	35	64	25	57	64		39	60	14		27	15	9	69	49	92
Sonora-70	50	15	30	50	27	69	31	46	56		39	31	11		27	37	11	72	57	96

What appeared to be Fusarium Wilt was observed in the research plots approximately 1½ years after establishment and over the next 10 months seriously affected stands. Fungi isolated from diseased roots have been tentatively classified by forage pathologists at the U.S. Regional Pasture Research Laboratory as Fusarium (2 species); Cylindrocarpon; Rhizoctonia; an unidentified Phycomycete; and another unidentified fungus that appears to be associated with black, rotted areas on the roots. Further efforts will be made to determine the identification and pathogenicity of the fungi involved in the root rot problem.

Stand Persistance:

Stands for all varieties were considered good to excellent and were similar for the first 17 harvests. Differential stand thinning was noted as the time of the 18th harvest when stand percentages were estimated. Stand estimates by varieties for harvests 18 through 20 and two harvests taken after the official completion of the study are given in Table 8.

Final stand estimates were made six months after the study was concluded by a team of four observers and are reported in Table 9.

While there is considerable variation from replication to replication the observations suggest that after 2½ years of harvesting, stands of Mesa Sirsa and Hayden were superior to stands of the other varieties.

Table 8. Estimated Percent Stand After 17 Harvests of Five Alfalfa Varieties at BARTAD (Avg. of 4 Replication).

	Percent Stand				
Variety	8/10/76	9/16/76	10/27/76	1/25/77	3/7/77
Mex-Son-R	47	70	41	36	27
Mex-Son	55	66	46	27	28
Mesa-Sirsa	67	82	76	57	50
Hayden	74	84	82	61	46
Sonora 70	71	71	52	24	24

Table 9. Average Estimated Percent Stands (1) by Replications of Five Alfalfa Varieties, Made April 15, 1977, After 2½ Years of Harvesting.

Vareity	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Ave. for 4 Reps.
	% Stand				
Mex-Son R	45	58	28	15	36.5
Mex-Son	15	38	50	40	35.8
Mesa-Sirsa	20	75	35	62	48.0
Hayden	40	45	42	60	46.8
Sonora 70	38	52	10	22	30.5

(1) Each estimate is the average of 4 independant observers.

Application of Findings to Andros

The results of this initial study indicate that with adequate fertility and management adapted alfalfa varieties will yield 8 to 9 tons of dry matter per acre per year for at least 2 and possible 3 harvest years, with nearly 50% of that production occuring during the cooler, dryer months of the year.

Of the 5 varieties evaluated Mesa-Sirsa and Hayden appeared to be more persistent and were similar in yield and quality. Thus, until more information is available on other varieties, these 2 varieties should be used on pilot test farms and other farms on the Island.

Based on initial observations from this trial a total of nearly 175 acres of either alfalfa or alfalfa-grass mixture have already been sown to the Mesa-Sirsa variety on the research station and pilot test farms. To-date there is no evidence of any variety related disease or insect problems. Nevertheless it would be desirable to include at least 1 more variety (Hayden) in any future seed orders.

Another trial comparing several alfalfa-grass mixtures has also been completed at BARTAD. While Mex-Son was the alfalfa variety used in that trial there were several mixtures that produced dry matter yields equal to or superior to yields of pure alfalfa. Quality-wise, protein levels of mixtures were 2-3% lower than for straight alfalfa but IVDMD levels were similar. From a management standpoint, therefore, it would seem that either straight alfalfa or suitable alfalfa-grasses mixtures can be grown for hay. However for pasture the inclusion of a compatable grass would be desirable, particularly to minimize the bloat problem.

The economics of alfalfa production at BARTAD using information currently available have been developed in other BARTAD reports (see Final Report #15 "Economic Analysis of Beef Production on North Andros Island, Bahamas").

Briefly, based on present data the total per acre cost for establishing an alfalfa-buffelgrass mixture varied from $314 to $317 depending on the management level. Of this cost $200 to $250 was for fertilizer. The annual maintenance costs varied from $150 to $200 again depending on management level.

To-date at BARTAD observations on persistence and utilization of alfalfa or alfalfa-grass mixtures under grazing conditions with either sheep or cattle are very limited. However, it would appear that under expected grazing management practices not more than 2/3's of the forage produced would actually be utilized.

Thus, initial small plot studies indicate that annual dry matter yields of 8 or more tons/acre are possible with either adapted varieties of alfalfa or alfalfa-grass mixtures. However, the economics of growing this crop either for hay or pasture has not yet been established.