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OBSERVATIONS ON THE PERFORMANCE OF SEVERAL TROPICAL LEGUMES

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Observations on The Performance of Several Tropical Pasture Legumes at the BARTAD Project, North Andros Island, Bahamas

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The value of legumes as pasture and hay for all kinds of livestock, and as cover crops, is well established through-out the world. Reasons for their importance include:

1. They have large amounts of protein in their leaves, stems and seeds and are, therefore, highly desirable as pasture, hay and silage.

2. They are an excellent source of: important bone building minerals such as P, K, and Ca; several vitamins; and growth promoting substances.

3. Through the process of symbiotic nitrogen fixation, when supplied with the proper nodule-forming bacteria, they utilized nitrogen from the air which is unavailable to non-leguminous plants.

4. They serve as soil builders, improve fertility and organic matter levels, and aid in protecting the surface soil from erosion.

Since the BARTAD project was initiated in 1973 a number of tropical legume species and cultivars have been established and observed in small plots on the research center. Several of the legumes have also been established in approximately 525 acres of pastures on the research center and pilot test farms. The purpose of this report is to describe all of the legumes which have been established, to summarize the observations and to indicate those species which appear to be best adapted to the Bahamas and have made the greatest contribution as pasture for cattle, sheep and goats.

Studies have also been completed on alfalfa (Medicago sativa), a legume grown in temperate, sub-tropical and tropical regions of the world. The results of these studies are reported in BARTAD Final Reports 19 & 20 - Performance of Five Alfalfa Varieties at the BARTAD Project, North Andros Island, Bahamas; and Performance of Five Alfalfa-Grass Mixtures at the BARTAD Project, North Andros Island, Bahamas.

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 ppm (very low), iron 10 ppm (low), copper 14 ppm (normal), zinc less than 20 ppm (low) and sodium less than 50 ppm (normal).

Rainfall averages from 46-52 inches annually with the dry season beginning in December and ending in May. However, seasonal and total rainfall may be highly variable from year to year and has a marked influence on total and seasonal crop production.

Maximum day time temperatures range from 90-95°F and occur during the period of May - October. Minimum night-time temperatures (40-50°F) occur during December - April.

Description and Observations

Twelve different species of tropical legumes were planted in small plots for observation. A list of these species and the seed source is given in Table 1. The following section gives a description for each species and observations of its performance at the BARTAD project site.

Table 1. Common Name, Scientific Name and Seed Sources of Tropical Legumes Planted for Observation at the BARTAD Project, North Andros, Bahamas

Common Name	Scientific Name	Seed Source
Centro	Centrosema pubescens	Australia
Greenleaf desmodium	Desmodium intortum	Australia
Greenleaf desmodium	Desmodium intortum	Florida
Silverleaf desmodium	Desmodium uncinatum	Australia
Lablab (Bonavis)	Dolichos lablab	Australia
Lablab (Bonavis)	Dolichos lablab	North Andros
Copper glycine	Glycine wightii	Australia
Tinaroo glycine	Glycine wightii	Australia
Leucaena (Jumbey)	Leucaena leucocephala	Australia
Leucaena (Jumbey)	Leucaena leucocephala	North Andros
Leucaena (Hawaiian Giant)	Leucaena leucocephala	USDA
Puero	Pueraria phaseoloides	Australia
Siratro	Macroptilium atropurpureum	Australia
Townsville stylo	Stylosanthes humilis	Australia
Townsville stylo	Stylosanthes humilis	North Andros
Stylo	Stylosanthes guyanensis	Australia
Stylo	Stylosanthes guyanensis	Florida
Verano stylo	Stylosanthes hamata	Florida

CENTRO

Centro (Centrosema pubescens) is a twining perennial legume native to South America. The stems are long and vigorous growing, rooting moderately at the nodes and capable of extending 14 feet in a summer. It grows best in areas receiving over 50 inches of rainfall per year but will withstand a long dry season. Centro will survive quite severe frosting, but does not grow well in cool weather even if moisture and light are adequate. It's adaptable to a variety of soil types. Centro will grow on medium fertile soils and responds well to superphosphate and minor elements. Centro is moderately tolerant of poorly drained conditions. It grows well with a wide range of grasses.

At the BARTAD project Centro was planted in several small plot trials and in the first pastures seeded in 1974. It was thought that centro would do well because a wild centrosena sp. was found growing on Andros Island. However, in the pastures only a few centro plants became established and many of these did not survive the first year of grazing.

In the observational plots consisting of pure stands of legumes, the centro was very slow in becoming established. In fact, it was 12 to 15 months before the centro started growing with any vigor. After the centro became established it grew moderately well and produced a good crop of seed during the winter and early spring months. Centro showed several micro element deficiency symptoms and this may have affected its establishment and growth rates.

In another trial, centro was planted with green panicgrass. When irrigated and harvested at 3, 4 or 5 week intervals it was the second most productive of the three legumes in the trial (siratro was higher, Townsville stylo lower). But when not irrigated it was the lowest yielding of the three legumes (for more information see Final Report #25, Irrigation, Harvest Interval and Nitrogen Effects on the Yield of Forage, Crude Protein and Digestible Dry Matter from Green Panicgrass alone and with Centro, Siratro or Stylo).

GREENLEAF DESMODIUM

Greenleaf desmodium (Desmodium intortum) is a trailing perennial legume native to Central America. It is a rather coarse spreading plant with thicker stems which root down well. It grows best in areas with rainfall of over 35 inches per year. It is very versatile in soil requirements and has some tolerance to water logging. Greenleaf is sensitive to frost. It combines well with a wide range of grasses.

Greenleaf desmodium was planted in several observational trials and in several grazing trials. In the first observational trial it became established very quickly, 3 to 6 months, and grew very vigorously. During the fall and winter months greenleaf desmodium flowered profusely and set a good crop of seed. Its rate of recovery after clipping was the most rapid of any of the tropical legumes tested.

In the second observational trial, two cultivars of greenleaf desmodium, one from Florida, U.S.A. and one from Australia, were compared. The Australian

cultivar had a better growth rate than the Florida cultivar, but both produced a good crop of seed.

Greenleaf desmodium was planted in grass-legume mixtures in three grazing trials. In two of the trials in which it was planted with one of the following grasses: buffelgrass (Cenchrus ciliaris), bigalta (Hemarthria altissima), Rhodesgrass (Chloris gayana), or Transvala (Digitarice decumberes var. Transivala), the greenleaf dominated the stand. In fact in one trial the desmodium completely killed out the grasses - buffelgrass and Transvala. In all three trials the desmodium was very productive with yields up to approximately 8.5 tons per acre of dry matter per year. Animal weight gains were also very good on the desmodium pastures (see BARTAD Final Reports 45, 47 and 48).

SILVERLEAF DESMODIUM

Silverleaf desmodium (Desmodium uncinatum) is a trailing type legume native to Central and South America. It is more decumbent in growth habit than greenleaf desmodium and the stems are courser and more hairy. Silverleaf is less drought resistant and less able to withstand waterlogging than greenleaf. Palatability is not high and livestock take some time to become accustomed to it. Silverleaf will withstand light frost but is killed back by heavy frost.

In an observational trial, silverleaf was slow in becoming established. It was one of the lowest yielding of the legumes planted in the trial. During the winter months it did flower and set a small crop of seeds.

LABLAB (BONAVIS)

Lablab (Dolichos lablab) is an annual or biennial legume, which is widely distributed in sub-tropical areas around the world. It is found on many of the islands in the Bahamas, but its main use has been as a bean crop for human consumption.

Lablab is a vigorous, viny legume with large leaves. Its main growth period is the hot humid summer months. Lablab is reasonably drought resistant and will grow in areas with an annual rainfall as low as 20 inches. It is tolerant to cool temperatures and will continue growing during the winter. If leniently managed lablab will act as a biennial and provide good spring and summer grazing the second year. Lablab is very palatable, produces a good yield of high protein feed and may be used for grazing or ensilage. Lablab will be defoliated by frost, but will recover unless the frost was very severe.

Two cultivars of lablab were planted in the observational trial, one local cultivar and one from Australia. Both became established quickly (4-6 months) but the Australian cultivar was slightly more vigorous. Both cultivars set good crops of seed during the winter months. The Australian cultivar flowered from 4 to 6 weeks earlier than the local cultivar.

The local cultivar was included in some of the earlier pasture mixtures on the research station. It provided a quick source of feed but then disappeared

under the grazing pressure used. Lablab was also planted in pure stands in several fields on the research station. One field was grazed with cattle and provided feed over a two year period. Another field was not grazed at all but was used for seed production. The seed was hand picked and thrashed. The yield was approximately 2500 pounds of cleaned seed from 13 acres or about 200 lb/A. The lablab was the first crop planted in this field after it was cleared and the fertility level was low.

On the first four pilot test farms, lablab was planted on several vegetable areas for a green manure crop and was also included in the mixed grass-legume pastures. The lablab in the pastures produced some feed the second year primarily because stocking rates were lower than those on the research farm.

GLYCINE

Glycine (Glycine wightii) is a trailing, twining legume which is widespread in tropical East and South Africa, Asia and East Indies. It is adapted to tropical and subtropical areas with annual rainfall of 30-60 inches. It is deep rooted and the trailing stems will produce roots at the nodes when in contact with the soil. Glycine generally requires higher fertility soils than other tropical legumes. It requires good drainage and will not tolerate water-logging. Glycine may be planted in pure stands or in mixtures with grasses. It will grow during cool weather but is sensitive to frost.

Two cultivars of glycine, tinaroo and cooper, were planted in the legume observation trial on the research station. Cooper glycine was slightly slower in establishment than Tinaroo. It was also slightly less productive. Both cultivars flowered and set seed during the winter months.

On the basis of its performance in the observational trial Tinaroo glycine has been included in pastures mixtures on the research station on approximately 85 acres. Several of these pastures have been grazed with cattle or sheep for at least one year and the glycine has performed extremely well.

On the pilot test farms, tinaroo glycine has been included in approximately 275 acres of mixed-grass legume pastures. Approximately 60 acres of this total has been grazed with sheep and goats for six months or longer. These pastures are now dominated by legumes Tinaroo glycine and siratro. In fact on most of the 60 acres the grass has been killed out by the legumes.

LEUCAENA (JUMBEY)

Leucaena (Leucaena leucocephala), a native of Central and South America, is a leguminous shrub or small tree. It can be found growing on many of the islands of the Bahamas.

Leucaena is adapted to tropical areas with an annual rainfall over 30 inches. This shrub has a deeply penetrating tap root and may grow at a rate of 8-18 feet per year if ungrazed. It may reach a height of 30-40 feet if ungrazed or uncut. It is quite drought tolerant and is able to maintain green leaves during dry

periods. Leucaena will combine with shade tolerant grasses such as guinea-grass. It can be grazed by cattle, goats or sheep but should not be used for horses or pigs because of its alkaloid (mimosine) content.

Two cultivars of leucaena, one local and one Australian, were planted in the observational trial. Both cultivars were slow to become established, 6-8 months. The Australian was slightly faster in establishment than the local and after establishment the Australian appeared to have a 25% faster growth rate. Both cultivars set good crops of seed during the fall and winter months with the Australian flowering from 4-6 weeks earlier than the local.

The local cultivar has been planted on approximately 15 acres on the research center. It was used because of the availability of seed. This leucaena has been grazed mainly by goats. It does not appear to produce as much feed as many of the other tropical legumes.

Another leucaena cultivar, Hawaiian Giant, USDA P.I. 404037, was planted to evaluate if for possible use as windbreaks, shade trees, forage, and seed production. It was planted on December 18, 1975 in pots and then transplanted into the field on July 12, 1976. During the period of August 16 through November 17, 1976, the plants grew an average of six feet in height. The plants set a crop of seed during the winter and spring months. Approximately five pounds of seed was collected. By October 1977, the trees were from 18 to 25 feet tall and had trunks with a diameter of $3\frac{1}{2}$ to 5 inches at the base. They were also setting a second seed crop which appeared to be much larger than the first crop.

PUERO

Puero (*Pueraria phaseoloides*) is a vigorous, climbing, perennial legume native to South-East Asia, Malaysia and Indonesia. It has been called tropical kudzu but should not be confused with common kudzu.

Puero is deep rooted and its hairy stems may reach a length of 25-30 feet. These stems root at the nodes in contact with the ground and lateral or secondary stems are formed. It has large hairy leaves. Puero is best suited to areas with over 60 inches of rainfall per year. It is frost sensitive. Cattle must become accustomed to it, but it is high in protein (19%). Seedling vigour is usually good and it has the ability to smother weeds.

Puero was planted in the observational trial. Under Androsian conditions it was very slow in becoming established and never grew very vigorously.

SIRATRO

Siratro (*Macroptilium atropurpureum*) is native to Central and South America but the improved cultivar used in BARTAD plantings was improved by Dr. E. M. Hutton in Australia from two parent lines collected in Mexico.

Siratro is a deep-rooted perennial with trailing stems which root at the nodes. It is suited to subtropical and tropical climates with an annual rainfall

of 30-70 inches. Frost will defoliate it or kill stems back to older crowns. Siratro is very drought resistant, responds well to superphosphate and fixes nitrogen very effectively. It is persistant under heavy grazing once the plants are well established. Siratro can be grown with a wide range of grasses.

Siratro was planted in the legume observation trial. It was slower in becoming established than greenleaf desmodium or glycine, but faster than the other legumes in the trial. Its rate of recovery after clipping and its dry matter production appeared to be less than that of greenleaf desmodium but about equal to that of tinaroo glycine. Siratro blooms throughout much of the year but sets its best crop of seed during the period of November through February.

In another trial, siratro was planted with green panicgrass. This mixture had the highest dry matter yields of any of the legume-grass mixtures when irrigated and harvested every 3, 4 or 5 weeks. However, when not irrigated the siratro-grass mixture had the highest yields at the 5-week harvest interval, but was only the second highest at the 3-and 4-week intervals (see Final Report #25).

On the research center, siratro has been planted as a part of grass-legume mixtures on approximately 220 acres of pastures. Approximately 90 acres of these mixtures have been grazed for three years and the siratro stands are from fair to excellent. Several other pastures have been grazed for one to two years with siratro stands still rated as good to excellent. However, on approximately 50 acres of pastures the siratro has been all but crowded out by the greenleaf desmodium in the mixtures.

Approximately 325 acres of tropical grass-legume pastures containing siratro have been seeded on pilot test farms. Out of the total acreage, approximately 50 acres have been grazed for one year or longer by cattle, goats or sheep, and the siratro stands range from fair to excellent. On some of the newer pastures, siratro is the dominant plant.

TOWNSVILLE STYLO

Townsville stylo (*Stylosanthes humilis*) is a free-seeding annual legume which is a native of the sub-humid and semi-arid zones of South America.

Townsville stylo is adapted to tropical areas with an annual rainfall of from 20 to 50 inches. It is low growing with erect stems. Townsville stylo germinates at the beginning of the wet season, grows strongly through the summer, and flowers in early to late autumn. It will survive part of the winter with adequate moisture. The amount of seed set is important to ensure regeneration the following year. Townsville stylo is adapted to a wide range of soils providing drainage is adequate. It has a remarkable ability to extract phosphorus from soils which are low in this element.

Townsville stylo was planted in the legume observation trial. The seedlings when they emerged were very chlorotic and most of them died. A few plants reached heights of 6-8 inches before they died.

Townsville stylo was also planted in a stylo observation trial. In this trial it grew but was not rated very high in comparison with several other stylos (see Table 2).

STYLO

Stylo (Stylosanthes guyanensis) is a perennial legume native to Brazil. It is an erect herb or small shrub 2-6 feet tall which may become more prostrate under grazing conditions. Stems are course and hairy, becoming woody with age. Stylo is suited to warm humid zones with an annual rainfall in excess of 50 inches. It is adapted to a wide range of soils, including those of low fertility and is somewhat tolerant of poor drainage. Stylo varies in its acceptability by cattle.

Stylo was planted in an observational trial comparing 20 different stylos of several stylosanthes species. Visual ratings of the different stylos after approximately five months of growth are presented in Table 2. As can be seen in the Table, three of the stylos were rated very high. They ranged in height from 12 to 15 inches and were classed as semi-decumbent types.

Table 2. Visual Ratings of the Growth of Twenty Stylosanthes at the BARTAD Project, North Andros, Bahamas.

Plot			Rating
Stylosanthes guyanensis	IRFL	620	3 (A)
Stylosanthes guyanensis	IRFL	780	1
Stylosanthes guyanensis	IRFL	856	2
Stylosanthes guyanensis	IRFL	951	2
Stylosanthes guyanensis	IRFL	1065	9
Stylosanthes guyanensis	IRFL	1164	3
Stylosanthes guyanensis	IRFL	1169	2
Stylosanthes guyanensis	IRFL	1185	1
Stylosanthes guyanensis	IRFL	1199	10
Stylosanthes guyanensis	IRFL	1202	1
Stylosanthes guyanensis	IRFL	1213	1
Stylosanthes guyanensis	IRFL	1234	4
Stylosanthes guyanensis, Endeavour			9
Stylosanthes scrabra	IRFL	1328	10
Stylosanthes subsericea	IRFL	970	7
Stylosanthes hamata	IRFL	1233, Verano	9
Stylosanthes mucronata	IRFL	1325	4
Stylosanthes humilis, Townsville			3
Stylosanthes humilis, Townsville			5
Stylosanthes humilis, Local Seed			5

(A) 0 equals no growth and 10 equals excellent growth.

The cultivar Endeavour looked excellent and seed was ordered for field plantings. However, the seed of the cultivar Cook was substituted in place of the Endeavour seed. This seed was planted in several pastures on the research center and appeared to be growing satisfactorily.

VERANO STYLO

Verano stylo (*Stylosanthes hamata*), also called caribbean stylo, originated on the islands of the West Indies and the adjacent coastal regions of North and South America. It can be found on many of the islands of the Bahamas.

Verano stylo is similar in appearance to Townsville stylo and is an erect smooth stemmed herbaceous plant. It is inclined to behave as a perennial especially when continuously grazed. It appears to outyield Townsville stylo, will also grow on a wider range of soils and is more drought tolerant. Verano stylo competes well with companion grasses and weeds once it becomes established.

Verano stylo was planted in the stylo observational trial and was rated very high (see Table 2). Based on these results seed was ordered for the research center. However, no results are available from pasture plantings.

Evaluation

The fifteen different legumes can be separated into three groups based on their performance in the small plots and in the pastures.

1. The first group is made up of those which have grown extremely well in plots, pastures or both plots and pastures. They are: greenleaf desmodium, tinaroo gylcine, siratro, stylo, verano stylo, cooper gylcine, both local and Australian lablab, and all three cultivars of leucaena.

2. The second group is made up of those which performed only fairly well in plots or pastures. They are centro and Townsville stylo.

3. The third group is made up of those legumes which did poorly and includes puero and silverleaf desmodium.

Seed Production

All of the legumes observed have flowered and set seed under the local conditions. However, it has not been proven that the seed produced by puero, silverleaf desmodium, or the glycines is viable.

Greenleaf desmodium, siratro, lablab, leucaena and the various stylos all produce good crops of seed. With the problems involved in obtaining seed for pastures in the Bahamas, and also the demand for tropical legumes seeds in other areas, it might be possible to harvest seed from some of these legumes for home markets and also for export.

Insect and Disease Problems

All of the legumes suffered damaged at some time from insects. The following insects were observed damaging both observational plots and field stands at the BARTAD site: fall armyworm, spodoptera tragiperda; yellowstriped armyworm, spodoptera ornithogalli; Southern armyworm; saltmarsh caterpillar, Estigmene acrea; a webworm of possible Loxostege species; and a green aphid.

The most damaging of the insects on greenleaf desmodium is the webworm. At times it will almost defoliate greenleaf stands. However, the desmodium seems to recover without suffering permanent damage. Siratro and the glycines were damaged most by chewing insects such as the armyworms. Lablab suffered most of its damage from the saltmarsh caterpillar. Aphids were observed on the leucaena but no visual signs of damage could be seen.

Unidentified rusts and leaf spots were observed on some of the legumes but did not appear to cause any serious damage.

Application of Findings to Andros

Results from observational trials, grazing trials and general production pastures indicate that there are a number of tropical legumes which will do well under local conditions. These legumes can be used for a number of purposes such as pasture, hay, ensilage, green manure crops and possibly for windbreaks.

The legumes which appear to be the best for long term pasture are: greenleaf desmodium, siratro, and tinaroo glycine. There are several others which can also be used for long term pastures but may not be quite as productive. These are: stylo, verano stylo, Townsville stylo and leucaena. All of the legumes named above can be grown in mixtures with other legumes and grasses or in pure stands. At the BARTAD project a total of approximately 530 acres have been planted using mixtures or pure stands of the aforementioned legumes. Siratro and tinaroo glycine have been planted on a much large acreage than greenleaf desmodium, but this is due only to availability of seed.

Lablab can be used for short term pastures or as a green manure crop. The local cultivar of lablab has been used on the research center and the pilot test farms for both of these purposes. It has performed satisfactorily when given adequate levels of fertilizer.

The legumes such as greenleaf desmodium, siratro, tinaroo glycine and the stylos can be used for hay. At the BARTAD project and associated farms, mixtures of siratro, tinaroo glycine and several grasses have been harvested for hay. These mixtures have produced from medium to high quality hay.

Leucaena, especially the cultivar Hawaiian Giant, appears to have potential for use as windbreaks along vegetable fields.