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UNITED STATES DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE
WASHINGTON, D.C. 20250

February 27, 1975

SUBJECT: Trip Report on Pasture Improvement in the Bahamas by Dr. A. J. Oakes - ARS Research Agronomist

TO: Quentin West/Lyle Schertz, ERS
W. A. Faught/E. Farstad/J. B. Davis/P. Wetmore, ERS
K. A. Haines, IPD/ARS
Michael Galli, TA/AGR, AID
Memory Bank, AID

Attached is a copy of subject report by Dr. A. J. Oakes following a recent TDY trip to the Bahamas. Dr. Oakes has made 2 or 3 previous trips in efforts to introduce various varieties of grass and legumes which might be adaptable for pasture improvement in the Bahama Islands.

Note on the first page the purpose of his trip followed by summaries relative to each of the plant varieties which have been introduced during the past few months. Description of activities relative to grazing trials are found on pages 10 and 11. A summary of his findings and recommendations will be found on pages 11 to 13.

Marshal Fox
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Attachment

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Reference Center
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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NORTHEASTERN REGION
AGRICULTURAL RESEARCH CENTER
BELTSVILLE, MARYLAND 20705

January 21, 1975

Subject: Trip Report - USAID Livestock Project, Bahamas, January 6-11, 1975

To: Mr. J. M. Halpin
Agency for International Development
Washington, D. C.

The purpose of this trip was to assist in an assessment of the progress in experimental research on forage crops, pasture establishment, and forage utilization. This was done in cooperation with the local technical staff, Drs. John Baylor, Pennsylvania State University and A. E. Kretschmer, Jr., Florida Agricultural Experiment Station, Fort Pierce, Florida. This report is based largely on the results of consultation with members of the local technical staff whose contribution and cooperation is appreciated.

Seed stocks of six rice varieties were hand carried to the Project. These are to be included in a monthly date-of-seeding trial recommended by rice consultants from the Rice Experiment Station, Crowley, Louisiana. The Rice Experiment Station, Crowley, Louisiana, has furnished the following varieties for this test: Brazos, Bluebonnet, Labelle, Nortai, Saturn, and Starbonnet (see enclosed CR Form 7).

Local environmental factors which affect forage crop production have been ascertained and repeatedly reported in previous reports of consultants in various disciplines. They include such phenomena as total annual rainfall and distribution, availability, quantity and quality of irrigation water, evaporation rate, seasonal and diurnal changes in temperature, soil type, pH, and water retention capacity. These data need not be repeated nor these phenomena discussed.

Notes and Observations

The constant changes which occur on a Project of this nature are more discernible to one who makes semi-annual visits as I have during the past year. Much physical progress is apparent; i.e., more land cleared, additional fencing, new office building completed and occupied, trench silo completed and partially filled and so forth.

Observations and notes were taken on the small-plot experimental plantings in Block 2-13. These observations and notes were made firstly by the writer and later in company with Drs. Baylor and Kretschmer and Mr. Cayton and Mr. Stern.

Small Introduction Plots

LEGUMES-

Medicago sativa Alfalfa

The variety trials of alfalfa look exceedingly good at this point in time. I understand that two harvests have been made since establishment. At present the ratoon growth on a few varieties; i.e., 10-25% bloom stage indicates they are mature enough for another harvest. In order to ascertain comparative varietal performance the entire test should be harvested at once. I believe that this is being done. This being the case, some medium developmental stage should be selected as the harvest interval which takes into consideration all of the cultivars in the test. The practice of repeated harvests based on the growth and physiological development of the plants is as it should be.

In addition to what has been done and is continuing in this variety trial, the following specific recommendations are made.

1. Harvest all varieties simultaneously (including the one variety which was planted late) based on an average blossom percentage.

2. Take notes on any discernible reductions in stand during subsequent harvests and ascertain possible causative factors.

3. Take notes on weed encroachment accompanied by reductions in stand.

4. Yield data for the late-planted variety should be included in the statistical analysis used at the termination of the trial. The discrepancy in the number of harvests for this variety should be explained.

5. Perhaps some consideration should be given to allowing the plants to reseed at some time during the trial.

The appearance and performance of alfalfa at the present time has exceeded by far my expectations. Perhaps this may be attributed in part to the availability of varieties which are superior to those which were available two decades ago.

Desmodium intortum

The cultivar 'Greenleaf' exhibits excellent growth in pure stands; it has matured a heavy seed crop under local conditions. The known widespread adaptation of 'Greenleaf' and its growth and seed production capacity under local conditions warrant its increase and inclusion in extensive trials, to include those of farm scale. Additional research on the mechanization of seed harvest and planting is needed. These will continue to be the limiting factors which limit further exploitation of this valuable legume. Its forage and seed production

justify its increase despite its known limitations. This legume forms compatible grass-legume combinations and persists well under grazing management.

The cultivar 'Silverleaf' exhibits inferior growth compared to that of 'Greenleaf'. It does not warrant increase in my opinion.

Stylosanthes species

Stylosanthes hamata

S. hamata (L.) Taub., known as Caribbean Stylo, has produced good growth and seed production for some accessions. Those accessions (all Dr. Kretschmer's material) which exhibit good growth and heavy seed production should be evaluated further in grass-legume combinations. My suggestion is to select two or three accessions for further evaluation; these should be large types with erect growth habit.

S. guyanensis

S. guyanensis is very chlorotic and not worthy of further increase and evaluation.

Leucaena leucocephala

The Leucaena plot should have been replanted in order to establish a complete stand. In view of the partial stand it is recommended that another small plot be established by using a heavy seeding rate at the onset of the forthcoming wet season. Seeding should be done in rows about 2.5-3.0 feet wide. Seeding rate should be sufficient so that the plants could be thinned to one plant about every six inches apart. The plants should be cut back to about three inches in height after they have attained approximately three feet in height. The paramount purpose of this plot is for demonstration.

Pueraria phaseoloides

Tropical kudzu exhibits very poor growth and severe chlorotic symptoms. Based on its performance, thus far, it is of doubtful potential value.

Trifolium species

Clovers do not have a place in the grassland agriculture of the Bahamas due to their slowness in becoming established and their small size drastically reduces their competitiveness and usefulness in grass-legume combinations. Furthermore, clovers are highly susceptible to iron chlorosis when grown on alkaline soils. They do not establish fast enough for use as a pioneer crop.

Glycine wightii

G. wightii should be increased and evaluated more extensively. Its growth habit, persistence, and seed production render it ideal in grass-legume mixtures for use as pasturage.

Macroptilium atropurpureum Siratro

Siratro, along with Leucaena leucocephala, Desmodium intortum 'Greenleaf', and Glycine wightii should be evaluated further in pure and mixed stands.

Specific recommendations regarding established introduction blocks of legumes and the introduction and evaluation of additional legume species include those listed below.

1. Replant certain legume introduction blocks as required; i.e., 'Silverleaf' Desmodium and Tan-Tan, Leucaena leucocephala. This does not mean replanting the entire block but replant to the extent of insuring a complete stand.

2. Use a vacuum machine to collect seed of certain legumes; i.e., Siratro and Stylosanthes hamata. These seed would require cleaning prior to planting.

3. Establishing introduction blocks; i.e., 6-8 rows, of:

   a. Rhynchosia minima - (Seed stocks are available in an old sorghum field near the warehouse near airport).

   b. Tan-Tan - (See Leucaena above).

   c. Dolichos lablab - (Seed stocks available locally). You have white seed and brown seed forms I believe. These should be established in separate blocks as there appears to be a difference in growth habit and maturity.

   d. Vigna luteola and V. repens - (Seed stocks will be made available from SRPIS before July 1, 1975; see enclosed copy of my January 15, 1975, request.

   e. Phaseolus lathyroides - (Seed stocks will be made available from SRPIS before July 1, 1975).

   f. Peanuts - (Seed stocks to be supplied by ARS). Establish in dates-of-planting test.

4. Take agronomic notes on all introductions at regular intervals throughout the year. Information like percentage stand, growth rate, rapidity (i.e. months from planting to complete cover) and extent of ground cover, blossom and seed maturity date, plant growth habit and

size are all important in the assessment of new species. The necessity of taking complete notes regularly on all plant introductions cannot be overemphasized.

GRASSES-

Observations have been made and recorded on the grass introductions twice at 6-month intervals; i.e., June, 1974-January, 1975. These observations were made on single hills, rows, or plots, and on replicated plots of those species introduced from Puerto Rico. These notes include: presence or absence of diseases and insects, plant vigor, plant spread (growth rate), and stand density (for sodforming types). These observations have been recorded on a scale.

Digitaria species

Thirty-seven (37) accessions have been introduced as vegetative stocks and established; of these, 13 accessions failed to survive. 'Transvala' digitgrass is superior in performance to the other 36 introductions and it should be increased and evaluated further, to include grazing trials on the Project site and established on pioneer farms.

Potash (K_2O) deficiency symptoms were observed on the following accessions: P.I. 299610 D. diversinervis, 299878 D. valida, and 299892 D. setivalva.

Pennisetum clandestinum kikuyugrass

Vegetative stocks of four accessions were established in January, 1974; all survived. This species appears slightly chlorotic and apparently makes its maximum growth during the cool winter months. This material should be retained and not discarded.

Hemarthria altissima

Vegetative propagation stocks of 19 accessions have been planted in single introduction plots. USDA P.I. 299994 and 299995 (obtained from Puerto Rico) were established in replicated plots. USDA P.I. 299995 is superior in vigor, aggressiveness, and stand density to the other accessions and should be increased and evaluated further in grazing trials.

In addition, several other Hemarthria accessions have demonstrated good adaptability to local conditions based on their growth rate and aggressiveness (ability to spread into areas from original planting) competitiveness with weeds which is demonstrated by their stand density, and overall vigor. Provided labor and space are available it is recommended that seven accessions be established in small-block replicated trials to assess (1) growth habit; i.e., prostrate, erect, semi-erect, and height at maturity (2) rapidity of ground cover following planting (3) aggressiveness, (4) competitiveness (5) vigor and (6) yield of green and dry matter and crude protein (CP) per hectare per annum. Items 1-5 inclusive, would be comprised of recording observations whereas comparative yields would be ascertained

by repeated cuttings for Item 6. Based on their behavior thus far the following USDA P.I. numbers should be included: P.I. 299994, 299995, 364865, 364866, 364871, 364887, and 364891.

Echinochloa polystachya Alemangrass

This coarse perennial, which roots at the lower nodes, should be discarded and destroyed. It is a serious weed in certain areas of the tropics whereas it is planted for pasturage in other areas.

Paspalum species

Bahiagrasses P. notatum and Dallisgrass P. dilatatum should not be evaluated further. Other species are superior on the alkaline soils of the Bahamas.

Pennisetum purpureum Napiergrass

Currently, there are four Napiergrasses established at BARTAD; i.e., (1) common or local, (2) Merker, (3) Merkeron, and (4) 'Panama' (P.I. 300086). It is recommended that these be placed in small-plot replicated trials to assess production capacity. Reprints of "Effect of Nitrogen Fertilization and Plant Spacing on Yield and Composition of Napiergrass in Dry Tropics" and the "Germination of Elephant Grass" are included as enclosures to this report.

Cenchrus ciliaris Buffelgrass

The accessions established should be retained although at this time no further increase is advised.

Cynodon species

The socalled "Stargrass" C. plectostachyus from Puerto Rico should be increased for grazing trials. One other introduction has some potential based on its behavior over a very short time; i.e., Cynodon sp. P.I. 364593. Both of those accessions are superior to the local types of bermudagrass.

Chloris gayana Rhodesgrass

The stoloniferous Rhodesgrass, obtained from Puerto Rico, should be evaluated further in its introduction blocks prior to making a decision as to whether or not it warrants increase.

Brachiaria species

Three species of Brachiaria appear to be well adapted judged by their growth. They include the following accessions (all of which came from Puerto Rico and are established in replicated blocks) B. decumbens, B. ruziziensis, and Brachiaria sp., called "Tannergrass."

Tannergrass was collected by the writer at Estcourt Research Farm, Estcourt, Natal in 1964 (see enclosed copy of CR Form 33). There appears to be some question as to its identity which requires clarification. The enclosed CR Form 33, A26599 indicates that this grass was initially distributed to Dr. J. Velez-Fortuno in Puerto Rico under the name Brachiaria sp. It was later planted at the Corozal substation in western Puerto Rico by Dr. Sotomayor-Rios. I observed this planting at that location in 1968. Herbarium specimens were submitted by Sr. A. Sierra-Bracero to our Laboratory in 1969 in an effort to get it identified as to species (see enclosed copy of CR Form 105). The specimens were identified as Brachiaria mutica (Forsk.) Stapf. The plant introduction assigned to this accession in Puerto Rico is PR 6451 and the USDA P.I. is 299499. The identity and accession numbers associated with this grass are last substantiated in the enclosed copy of a recent article by Sotomayor-Rios, Julia, and Arroyo-Aguilu Jour. Agr. Univ. P.R. 58:448-455. 1974; see first entry in Table 1, page 449. In our opinion this low-growing slightly yellow grass now in the replicated plots at BARTAD is indeed "Tannergrass," B. mutica. The records of Germplasm Resources Laboratory and those of the University of Puerto Rico are in accord on this point. Dr. Baylor's records indicate it was introduced from Puerto Rico under PR 6451 (see page five of my July 22, 1974, Trip Report).

All three species should be maintained and evaluated further. Tannergrass, and probably B. decumbens, should be included in grazing trials. While the grasses remain in the introduction blocks notes on seed production would be of immeasurable value for future use, provided any of them produce seed.

Yellow sugarcane aphid, Sipha flava, was found on Bahiagrass, Buffelgrass, Setaria species and Pangolagrass. The infestations were light and apparently have not reduced plant growth and production appreciably.

Specific suggestions regarding the introduction blocks of grasses include those listed below.

1. Observe and record at periodic intervals the following on all grass introductions:

   a. Method of establishment

   b. Dates of planting

   c. Duration from planting to establishment of complete ground cover

   d. Blooming, seed set, and seed maturity dates

   e. Plant growth habit and size

f. Aggressiveness

g. Competitiveness

h. Stand density

i. Disease and insect damage, by season if possible

j. Other phenomena as become appropriate.

2. Discard Echinochloa polystachya and Paspalum species.

3. Assess production capacity of 4 Napiergrasses in replicated block trials by determining yields of green and dry matter and crude protein. (See Pennisetum purpurem above).

4. Assess and record seed production of Brachiaria species.

5. Increase 'Transvala' digitgrass for extensive evaluation.

6. Assess comparative production capacity of seven Hemarthria accessions (see H. altissima above).

7. Assess and record seed production capacity of Cenchrus ciliaris by allowing the plants to mature seed. (N.B. All locally collected seed must be kept for 6 months or preferably 1 year in storage in order to obtain reasonably good germination).

8. Assess and record seed production of Chloris gayana, Rhodesgrass. Examine roots periodically for presence of Rhodesgrass scale.

9. Establish those warm-season grasses by seeding which were sent to BARTAD from ARS on July 16, 1974.

10. Yield data could be taken from introduction blocks if desired.

Increase Blocks for Propagating Stocks

Remove weeds and rocks from established propagating nurseries. The plant material now available should be used for further plantings. A smooth ground surface would allow close cutting of propagating stocks thus increasing the quantity available for a given period on a designated area. Weeding could be done manually or through the use of selective herbicides. The preparation of "seed patches" for increasing sodforming grasses by vegetative propagation should be thorough and complete. The use of fertilizer and irrigation to maximize growth and production is highly desirable and recommended. Be assured of sufficient size of propagating nurseries to insure that sufficient quantities of propagating materials are available when needed.

Notes on Established Production Pastures

1. Delete sorghum from future mixed stands in pastures.

2. The validity of including *Dolichos lablab*, along with other legumes, in grass-legume pastures is questioned.

3. Allow established guineagrass pastures to mature one seed crop per annum, preferably during the wet season. This is necessary in order to maintain and increase the stand.

The management of guineagrass under a cutting regime in the dry tropics is demonstrated by the enclosed reprint Agr. J. 58: 75-77. 1966. Based on my experience with this grass I would recommend that it not be cut below 6" at any time.

Guineagrass should not be grazed during the dry season unless it is irrigated.

4. Napiergrass management

A. Cutting regime

If the objective is using green chop feed on a daily basis, the grass may be cut as needed on a daily basis. Provided the cutting machinery could be left in the field this would minimize the movement of equipment and allow the grass to regrow following cutting. Cutting height should not be lower than 8-12 inches at any time. At one cutting during the year the height should be 18-20 inches and sufficient time allowed for the plants to reach approximate maturity before the next harvest. All harvests should be made when 60-85% heading has occurred.

B. Grazing regime

Graze grass when 75-90% mature. Grazing may be done at an earlier stage without damaging the stand. The livestock acceptibility and nutritive value of Napiergrass is drastically lowered on old grass; i.e., 9 months old or beyond. The grass may or may not be cut following grazing rounds. Provided the grass is cut following grazing the cutting interval and height should be similar to that described under cutting regime.

C. Cutting-grazing regime

The intervals between grazing and cutting should be of sufficient duration to allow the grass to maintain adequate root reserves. Under natural rainfall conditions the cutting and/or grazing intervals would vary depending upon season; i.e., wet-dry. The grass should not be grazed too intensively at any one time nor should it be cut too low. Follow the cutting regime outline.

N.B. The existing field of Napiergrass could be partially used in small scale grazing trials if desired.

Small Scale Grazing Trials

A. Sodgrasses

It is agreed by consensus to establish three sodgrasses in grazing trials. The purpose of these trials is to ascertain comparative livestock carrying capacity and beef production per hectare per annum. The three grasses, 'Transvala' digitgrass, Stargrass, Cynodon plectostachyus, and Hemarthria altissima, P.I. 299995, are to be established in a replicated plot design with 4 replications; paddock size is one acre. All grasses are to be established vegetatively utilizing irrigation if necessary in establishment. Plans call for the use of 500 pounds of 8-18-8 fertilizer per acre at establishment. Grazing regime is to be worked out with the animal husbandryman. I am uncertain whether or not subsequent fertilization and irrigation is planned for the trial. The grazing duration of such a trial should be a minimum of two years. Provided subsequent fertilizer is used without irrigation, and it should be included, split applications are recommended depending upon rainfall distribution. Provided irrigation is used split applications of fertilizer are also recommended.

B. Guineagrass with and without legume

Guineagrass is to be established broadcast by seeding in three treatments in replicated blocks with 4 replications.

Treatment 1. Guineagrass + 200 lb. N/A/yr.

Treatment 2. Guineagrass + 400 lb. N/A/yr.

Treatment 3. Guineagrass + Leucaena leucocephala

The Leucaena is to be seeded in rows with row spacing coordinated with width of equipment. Seeding rate should be sufficient to insure 3 to 6 plants per linear foot.

Fertilizer, 8-18-8, 500 lbs./A. is to be applied at establishment followed by split applications of N annually. The source of N should be uniform.

C. Bunch grasses

Cenchrus ciliaris, Buffelgrass; Rhodesgrass, Chloris gayana; and Greenpanic Panicum maximum var. trichoglume are to be established by seeding broadcast. Experimental design is comprised of three treatments with four replications. Plot size is 1 acre; total 12 acres. Forms of Napiergrass, depending upon availability, are to be used as a backup feed supply. The grasses may or may not be established in pure stands. 'Greenleaf' Desmodium, Siratro, and Glycine wightii could be used in all of the grasses to form grass-legume combinations.

Provided legumes were utilized 300 pounds of 8-18-8 are to be used at establishment. Subsequent additions of N should be applied in split applications from a common source at rates no greater than 300 pounds N/A/yr.

Large Scale Grazing Trials

Large scale grazing trials were planned. Details are included in Dr. Baylor's Trip Report.

Additional Recommendations

1. Some consideration should be given to endemic species for use as living fence posts for use on proposed farms.

2. Provide for a seed storage room at the earliest opportunity. Minimum requirements of temperature and relative humidity should not exceed 100. For example, Temperature 50°F; relative humidity 40 percent.

3. Establish a central library as soon as possible for the use of all personnel. Trip Reports of consulting scientists should be made available to the local staff on a need-to-know and timely basis. Quite often the recommendations made become obsolete prior to becoming known to the proper personnel.

4. Ensiling forage should be continued from year to year as a precautionary measure. This, despite the fact that none may be needed this current dry season.

5. It is now known that four legumes produce seed crops under local conditions; i.e., Siratro, 'Greenleaf' Desmodium, Glycine wightii, and Leucaena leucocephala. In addition, all form compatible grass-legume combinations under planned management regimes. With this knowledge it is recommended that seed stocks of these four legumes be saved from existing plantings for further expansion and utilization.

Summary

It is evident that much progress has been made on the Project during the past six months. The forage species have largely sorted themselves out during the past year. We now possess first hand knowledge on the performance of forage crops under local conditions. With this knowledge we are in better position to chart and plan future activities.

I am confident of the soundness of approach in the forage crop program. The results obtained thus far from the plant introduction and evaluation program substantiate this belief. My paramount concern for the future success of the forage crop and livestock program revolves around the current recommendations regarding (1) the use

of commercial fertilizers, (2) irrigation, and (3) livestock management. Existing livestock farming in the Caribbean is conducted on a very low management level. This is unfortunate, but a fact. Existing "pastures" include pangolagrass perhaps or guineagrass. Management consists of no irrigation, no weed control measures, and perhaps no fertilizer. The cost of commercial fertilizer has almost doubled in the past two years with no reductions foreseen within the foreseeable future. Regarding irrigation availability; will the pioneer farms have irrigation water and facilities available? If so, then the use of fertilizer on pastures at prudent levels is perhaps agronomically and economically feasible; otherwise the rainfall and its distribution; i.e., wet versus dry seasons will severely limit the use of fertilizers, especially in quantities now being employed on the Project in existing and planned pastures. The livestock carrying capacity of pastures in the Caribbean is less than one animal unit per acre annually. The management of livestock alone is an unknown quantity to the Bahamian farmer. Agricultural economists suggest that the fertilizer bill should not exceed 20% of the gross income per annum from livestock enterprises. Where would we be provided we applied this yardstick to the proposed pioneer farm? These questions are not for me to answer; they are posed to demonstrate the wide disparity which will exist between the livestock performance on the Project under existing conditions as compared to that of the "average" Bahamian livestock farmer.

In other words, I believe the use of fertilizer in our experimental trials and pastures should be drastically reduced from existing and planned levels. Furthermore, I am in agreement with Dr. A. J. Kretschmer in recommending that maximum utilization be made of legumes as a form of nitrification and excellent feed source. Also. I am firmly convinced that the use of irrigation should <u>not</u> be included in <u>all</u> future pasture studies. Why? Because the average farmer is not going to have this luxury at his disposal.

In view of the foregoing, which may be substantiated in many ways, three considerations are of paramount significance in my opinion. These are: (1) maximize the utilization of legumes in the establishment of all grazing pastures, (2) reduce the level of utilization of commercial fertilizers, (3) continue to conserve forage through ensilage. The first two considerations must be adhered to in order for the results of our trials to be projected to the level of management contemplated on the Bahamian farm. In the absence of irrigation the use of high fertilizer levels is agronomically and economically infeasible. The economic feasibility of livestock production must be scrutinized very carefully when the use of irrigation, high fertility levels, and high quality and costly

livestock constitute the program. What we are striving toward is livestock production on a management and economic level which will be somewhat compatible with that eventually being employed in the Bahamas. As it is the potential disparity between the two management levels is far too great in my opinion.

A J Oakes

A. J. Oakes
Research Agronomist
Germplasm Resources Laboratory

Enclosures:
(1) CR Form 7, 1-6-75.
(2) Effect of nitrogen fertilization and plant spacing on yield and composition of Napiergrass in the dry Tropics.
(3) Germination of Elephant grass.
(4) Effects of harvest intervals on the yield and composition of 10 forage grasses.
(5) CR Form 33, A26599.
(6) CR Form 105, 5-20-70.
(7) Effect of nitrogen fertilization and harvest frequency on yield and composition of Panicum maximum Jacq. in dry Tropics.
(8) Seed request, Oakes-Langford, 1-15-75.