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PANAMA AGRICULTURAL TECHNOLOGY DEVELOPMENT

PROJECT No. 525-0180

for the period

April 1, 1984 to June 30, 1984

DESCRIPTION OF ACTIVITIES OF PERSONNEL

Dr. Pedro Argel, Pastures Specialist

1. Species Selection

1.1 Background

In 1983, four different regional experiments were established in different Panamanian ecosystems with the objective of observing the adaptation of a number of genotypes (40-60) of forage grasses and legumes. Classified as Type A experiments, these studies have served as a means of making an initial selection of species in the ecosystems where they were established near Los Santos, Calabacito, and Sona. Los Santos is characterized by a high drought potential and Calabacito and Sona by acid, infertile soils. An experiment which was planted near Chepo, in eastern Panama, failed and is being reestablished.

1.2 Progress

After the first year of observations and a complete cycle of rainy/dry seasons, the best germplasm will be evaluated in an agronomic study (Type B) in El Ejido near Los Santos. Thirty-three ecotypes of grasses and legumes will be evaluated at the site. Land preparation for this experiment is now underway.

An additional benefit of these experiments has been to show the general need for finding germplasm adapted to other ecosystems of Panama. Dr. Argel is assisting IDIAP livestock specialists in establishing other Type A experiments in other ecosystems. One of these will be established in El Coco near Penonome, in Cocolé Province. This area is characterized by acid, infertile soils with a 4-5 month dry period. The other will be located in Arena de Quebro, an area that represents a Very Humid Tropical Rainforest ecosystem similar to the Atlantic coast region of Panama. The germplasm has been selected for these experiments and they are currently being established.

A total of 25 ecotypes of Brachiaria resulted on the Gualaca Research Farm from the initial planting of 41 ecotypes from CIAT. These will be evaluated in various ecosystems of Panama with observations planned on: general adaptation, production, and tolerance to Neoplamia spp. the severe Brachiaria pest which has been reported in several locations in Panama. The selected sites include: Chepo in the Eastern Region, Calabacito in the Central Region, and Gualaca and the Chiriqui Farm in the Western Region. Land has been prepared and planting will begin in the near future.

Ninety-two ecotypes of Panicum spp. are being planted in Jiffy pots for later transplant to the field. These will be evaluated initially

for agronomic characteristics on the Gualaca Research Farm. There have been germination problems with this seed lot however, and the final number of ecotypes will likely be less than 92. Land has been prepared and the seeding is being planned.

An evaluation of 200 ecotypes of Leucaena spp. has been established in collaboration with the National Agricultural Institute (INA) in Divisa. The plants have been propagated in plastic bags and are ready for transplant to the field. The site has been selected and the land is being prepared for this experiment.

Efforts to find improved germplasm has also extended to the Chiriqui mountains (above 1,000 meters) where dairy farming predominates. An agreement has been established in collaboration with Dr. Gaskell to evaluate grass and legume germplasm for adaptation to zones of medium temperature (23-25°C.) and high rainfall (>4000 mm. annually). Germplasm obtained from the USDA Plant Germplasm Laboratory was established recently and this will ultimately be complemented with additional germplasm from other sources.

1.3 Future Plans

The selection process for forage species is one that starts with a large number of ecotypes and ends with relatively few that show good adaptation and production potential. The better ecotypes from these experiments will be evaluated under specific conditions of agronomic management such as cutting frequency, fertilization, etc. These agronomic (Type B) experiments serve as a basis for selection for the Type C Grazing Trials which involve animals. Finally, the best species are evaluated economically as part of commercial production systems under different management practices and these trials are termed Type D. Future plans include evaluations of Type A, B, C, and D, for each ecosystem, and finally determining the best adapted species.

2. Seed Production

2.1 Background

In 1983, a number of forage species were established at Gualaca for seed production. Existing parcels of Brachiaria humidicola, B. decumbens, and Andropogon gavanus at the Chiriqui Farm and Calabacito are also being used for seed production. All of these species produced seed and a total of 1.9 ton of crude, unprocessed seed of grasses and legumes was harvested.

2.2 Progress

IDIAP is convinced that seed production is an important factor in the promotion of a new forage species. With this in mind and based on last year's experience, IDIAP has increased the amount of area under seed production to include: 10.0 ha. of A. gavanus at the Chiriqui Farm, 2.0 ha. at Calabacito, 2.0 ha. at Los Santos and 10.0 ha. at

Rio Hato. There are also 5.0 ha. of B. decumbens at Gualaca in addition to the areas established last year. The land has been prepared at the Chiriqui Farm for A. gyanus and this planting will be made soon. The B. decumbens established at Gualaca is being managed for harvest at the end of June.

In addition to the seed production work, two experiments on cutting and fertilization of A. gyanus and Kudzu are planned. It is hoped that these experiments can be established in August. A similar experiment that will also include B. decumbens and S. guianensis has been proposed for Rio Hato on a farm recently given to INTAP by the Ministry of Agriculture.

3. Agronomy

An agronomic experiment has been established at Calabacito to study the response of A. gyanus and S. capitata to various levels of P, Mg, K, and S. During the establishment period, P showed the greatest effect but definitive results will not be obtained until the end of the year.

A similar experiment will be established in the next few weeks at the Chiriqui Farm with B. humidicola. An existing pasture on an Inceptisol soil will be used. This species has shown previous persistence problems at this site and this is believed to be related to fertility problems.

4. Evaluation and Management

Since 1982 it has been planned to establish Type C and D experiments at Gualaca with local germplasm and CIAT germplasm. Fences were built and some treatments were started in 1983. Some changes have been made in the Type C experiment based on the results of the different Type A experiments. Plans are underway to establish and evaluate species such as B. duttoniana, S. guianensis 136 and 184, Centrosema macrocarpum, and S. capitata 'Capica'. The inclusion of these forage legume species will enlarge the study beyond the ecotypes of Tropical Kudzu originally planned to other equally promising species. A Type D experiment is also planned for Calabacito. The species associations to be evaluated include:

<u>A. gyanus</u>	+	<u>S. capitata</u>	'Capica'
<u>H. rufa</u>	+	<u>S. capitata</u>	'Capica'
<u>A. gyanus</u>	+	<u>S. guianensis</u>	136 (and/or 184)
<u>B. duttoniana</u>	+	<u>P. phaseoloides</u>	(Kudzu)
<u>B. humidicola</u>	+	<u>P. phaseoloides</u>	

An alternate grazing management will be used with 28 days of grazing and 28 of rest. Stocking rate will be 2 animals/ha. in the rainy season and 1.3 animals/ha. in the dry season. The duration of the experiment will be two years.

It is worth noting that the species have been selected based on results from the first year's Regional Type A experiments. The observations

from those experiments and other observations of CIAT in similar ecosystems provided the basis for the treatment selection. The land site chosen for this experiment is being prepared and it is hoped to initiate the experiment during the present rainy cycle and initiate grazing in December of this year.

Plans have been finalized for a Type C experiment in collaboration with the Agronomy Faculty in Chiriqui. During 1982 the Faculty conducted a Type B experiment in collaboration with CIAT and an initial germplasm selection was made. This group of selected germplasm has been complemented by additional selections based on experiments conducted by INIAP during 1982. The experiment will be conducted on Ultisol soils which are characteristic of a large area of eastern Chiriqui Province. The treatments (species) include:

- A. gavanus + S. capitata 'Capica'
- H. rufa + S. capitata 'Capica'
- A. gavanus + S. guianensis 184 (and/or 136)
- B. dictyonera + P. phaseoloides (Kudzu)
- B. humidicola + P. phaseoloides

In this case, a rotational grazing management will be used with seven days grazing and 35 days of rest. The stocking rate will be three animals/ha. (1.25, 2.0, and 2.5 animal units/ha.). The land has been prepared and work is underway to establish the experiment. There is considerable interest in this experiment in the Faculty of Agronomy and by using it for student theses it will be possible to gather a considerable amount of data. Part of the seed has already arrived and the rest is arriving soon from CIAT.

One of the most serious problems in tropical pasture management is weed control; including broadleaf herbaceous and woody weeds as well as grasses. The weed complex changes from one site to another and some weeds are quite resistant to traditional control methods. A number of weed control experiments have been designed and they include the following:

- 1) control of Chumico (Curatella americana) and Varablanca (Casearia javitensis) with herbicides applied to the stem and leaves.
- 2) Control of Cabezona grass (Panicum virgatum) with foliar herbicide application.
- 3) Control of weeds during legume establishment with pre- and post-emergent herbicides.

These experiments will be conducted at the Qualaca Farm and in the area of Bugaba. These experiments will be initiated in the next few weeks.

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5. Other

Dr. Argel was invited by the Smithsonian Tropical Research Institute (STRI) in early May to provide advice at Barro Colorado Island in the Canal Zone. The STRI is looking for alternatives to the ecosystem destruction in the area and for erosion control possibilities to avoid the increasing sedimentation of the Canal.

Dr. Argel presented a plan to the STRI that involves the establishment of the forage species adapted to poor soils to control erosion. The plan includes some Brachiaria species and a few legumes. Two commercial ecotypes of Brachiaria humidicola and B. decumbens will be planted on a large scale to provide seed to producers in the short term. Two hectares of Kudzu will also be established to initially serve as a Protein Bank and after one year to be turned into the soil and an annual crop (maize or rice) will be grown for grain. This last alternative could serve as a rotation of pasture and grain crop to reduce the destruction of tropical forests for grain crop production. The STRI is planning to implement Dr. Argel's suggestions in the near future.

Dr. Mark Gaskell, General Agronomist

1. Maize and Dry Bean Research--Caisan Area

1.1 Background

The research program in the Caisan area is directed toward the agronomic problems of maize and dry beans, the principle crops in the area. In the case of dry beans, studies were initiated during the 1983 growing season to try to better understand the dry bean needs of nitrogen and phosphorus fertilizer. Previous studies have indicated little need for fertilizer by maize or dry beans in the area, but it is possible that the high rainfall and high phosphorus-fixing Andept soils which characterize the area have interfered with a clear response.

1.2 Progress

Statistical analysis of the 1983 dry bean data is continuing with the assistance of IDIAP's Biometrics Unit. The current system of data analysis which utilizes a central processing unit at the Controlaria offices is very cumbersome. It is necessary to edit the data using terminals in IDIAP's offices in Panama City and maintain a connection with the mainframe unit located several blocks away. The system is frequently out of service for one reason or other and thus, data editing and analysis is slow and difficult. There is considerable interest within the Biometrics Unit and discussions are underway to develop an in-house capability with some of the recently available microcomputer hardware and software packages. This would be a considerable improvement over the current system and at perhaps little if any added cost. An effort should also be made to provide similar capability in the Regional offices in Santiago and David.

Dr. Gaskell is continuing to work with IDIAP researcher Miguel Acosta to analyze the dry bean experimental results and plan experiments for the coming planting season in October. Preliminary observations of the bean data gathered from last season indicates a response to nitrogen and phosphorus that is somewhat variable between the three different experimental sites but quite profitable on two sites. Bean grain yield increases in response to nitrogen application up to 100kg. ha.^{-1} and this response is enhanced by the application of 50kg. P. ha.^{-1} . Approximately 2 quintals ha.^{-1} of beans would be required to supply these fertilizer levels, but the response on one farm was seven quintals and on a second was greater than 15 quintals. Current bean prices in the area are \$47.50/quintal. The third farm showed a much more variable response to fertilization perhaps because of greater weed competition and more disease problems. The exact nature of the fertilizer response awaits more complete statistical analysis and it will also be important to repeat these experiments in the coming growing season.

Dr. Gaskell visited the Bean Program at CIAT in Cali, Colombia in early May to discuss the possibilities of future collaborative work

with that program. As a result of meetings held during that visit it was decided that Dr. Aart Von Schonhoven, the head of the Bean Program, will visit Panama in September to discuss further research work with IDIAP researchers and Dr. Gaskell.

In the case of maize, several experiments were planted in Caisan during late March and early April and data collection is underway on these experiments. Research on maize is also concentrating on the response of the principle criollo maize variety, Caisan, to nitrogen and phosphorus fertilization. Additionally, other experiments underway in Caisan are investigating the productivity of the principle maize hybrid and open-pollinated varieties grown in Panama to different planting densities at non-limiting fertility levels. The results of these experiments will not only provide information on the optimal plant density for these varieties but also give an indication of the biological potential productivity of these varieties in the Caisan environment.

Dr. Randy Gaugler, an entomologist from Rutgers University visited Panama in late March to assess the problem of white grub (Phyllophaga spp.) infestation in maize and beans in the Caisan area. Dr. Gaugler also presented a seminar on the control of insects with parasitic nematodes to the Entomology Department at the University of Panama. White grubs are a major problem throughout Panama and in the rest of Central America as well. During Dr. Gaugler's visit, plans were made for a series of studies to investigate the use of such biological control agents as Milky Spore Disease and parasitic nematodes to control white grubs in the Caisan area. Samples taken from farmer's fields during Dr. Gaugler's visit indicate the presence of a native Milky Spore disease in the white grubs in the area. Although the native disease is not virulent enough to control the population at present, it offers promise for the use of Milky Spore as a control agent in the area. Parasitic nematodes may also be a potentially valuable biological control agent but little is really known about the nature of white grubs generally in the area or the specific potential of these control agents.

IDIAP entomologist Ileana Broce is working with CATIE resident entomologist Phillip Shannon to continue rearing collected white grubs in the laboratory to more thoroughly understand the taxonomy and ecology of the white grub species in the area. Dr. Gaskell, Dr. Gaugler, Ing. Broce, and Ing. Shannon are developing a research program in biological control of white grubs and an effort is underway to locate additional financing for the project.

1.3 Future Plans

Future activities in the Caisan will center around the collection of data from the maize experiments and continued analysis of the dry bean data. Planning will also begin soon for the dry bean experiments to be planted in October.

A sampling program to determine the extent and nature of white grub infestation in the areas of Caisan and Rio Sereno is planned for early July.

2. Onion Research- Cerro Punta and Boquete

2.1 Background

Panama normally produces onions during the period from mid-February to early May each year but importation of onions is quite high the rest of the year because onions cannot be stored longer than two to three months under Panamanian conditions. The research focus for onions is directed toward two primary areas; the agronomic problems associated with onion production during the rainy season and systems for onion drying to enhance storage life.

2.2 Progress

As a part of the research in onion drying, a prototype solar-heated onion drier has been constructed on a collaborating farm in Rambito, one of the principle onion production areas of Panama. A second trial of the onion drier was conducted in early April. The onions placed inside appeared to dry at a reasonable pace but there were considerable problems associated with the starting of the generator on a regular basis to provide for adequate venting of the humidified air. The collaborating farmer is unable to guarantee daily starting of the generator at present, so a trial is planned for later in June which will utilize IDIAP personnel to start and maintain the generator and hygrothermographs inside and outside the drier to follow the diurnal temperature and relative humidity fluctuations. It is important to try to quantify the actual drying power of the current drier design. An effort is also underway to design a ventilation power system which requires less frequent attention.

Onion agronomic experiments were planted with the beginning of the rainy season in Cerro Punta and Boquete in mid-May. One experiment which is currently underway will evaluate the development of 16 commercial and experimental onion varieties over four separate planting dates, one month apart. A new agronomic researcher was named to the onion program by IDIAP in early March. The new experiments which are underway will serve as an excellent in-service training opportunity for him and his assistance will enable Dr. Gaskell to coordinate a wider range of experiments. The work in Boquete is a recent addition to the onion research program which was suggested by IDIAP's Crops Research Directorate Director, Dr. Alejandro Ferrer. This activity will utilize periodic visits by Dr. Gaskell to the area to oversee experiments conducted by agronomists from the Boquete Horticultural Cooperative on the farm of onion grower, Rodrigo Marciacq. This will allow the accumulation of important research data on onions for the Boquete area even though IDIAP does not formerly have a research program in the area.

Other onion agronomic experiments which are underway in Cerro Punta will evaluate the effectiveness of several commercial fungicides on rainy season onions and the relative value of different seedbed management practices for enhancing rainy season onion production.

The fungicide experiment was planted on May 23 and is germinating reasonably well despite some soil compaction due to high rainfall. The treatments include an untreated control and weekly applications of the following commercial fungicides:

1. Dithane M45
2. Dithane + Daconil
3. Dithane + Difolatan
4. Dithane + Renlate

Data will be collected on disease incidence and plant development in the seedbed and after transplanting.

The seedbed management experiment is designed to evaluate potential improvements in seedbed management practice and includes the following treatments:

1. Untreated control
2. Soil drench of orthocide (captan) + furadan 10G at planting
3. Basamid (dazomet) soil disinfection
4. Plastic roof + orthocide/furadan
5. Plastic roof + Basamid.

Data will be collected on disease incidence and plant development in the seedbed and final yield after transplant.

2.3 Future Plans

Future activities will include the coordinating of the planting of planned experiments in Cerro Punta and Boquete and the collection of data from those experiments and experiments already underway.

3. Other Activities

Rutgers soil scientists Dr. Lowell Douglas and Dr. Harry Motto visited Panama June 3 to June 10, 1984. The primary purpose of their visit was threefold:

- a) to further elaborate a collaborative research project with IDIAP soil scientists on the nature of aluminum in Panamanian acid soils,
- b) to investigate future collaborative research efforts in clay mineralogy and micromorphology to aid IDIAP's soil classification and mapping program, and
- c) to collect soil samples to be used as part Master's thesis of IDIAP researcher Alfonso Singh who is currently working on an M.Sc. degree in Soil Chemistry under Dr. Motto at Rutgers.

Dr. Motto had visited Panama in late 1982 to evaluate analytical procedures and instrumentation needs in IDIAP's laboratories in Divisa

and Gualaca. This visit also allowed Dr. Motto a chance to followup on recommendations which he had made for the laboratory in Divisa and to see the recent instrument additions to the laboratory. Alfonso Singh will have primary responsibility for the soils laboratory when he returns to Panama.

The visit was extremely fruitful in that all three objectives were accomplished and the two soils researchers also had an opportunity to interact with Dr. Manrique and Dr. Gaskell over research underway in Panama. They also had an opportunity to visit many of the representative soils across Panama with IDIAP soils researchers Dr. Jorge Jonas, Ing. Benjamin Name, and Ing. Santander Jaramillo.

Dr. Luis Manrique, Soil Productivity Specialist

During two weeks in April, Dr. Manrique visited CIP and CIAT headquarters at Lima, Peru and Cali, Colombia, respectively. The trip to CIP was aimed to review current research on potato performance in tropical lowland conditions. Arrangements were made with Dr. Swing from Cornell University and CIP's seed unit to obtain in-vitro materials of six American cultivars. Dr. Manrique personally brought these materials from Peru and handed to IDIAP for multiplication in Cerro Punta. Such plant materials will be used for field experiments intended to validate current potato growth models. As it was stated in Dr. Manrique's work plan, the overall objective of crop simulation studies in Panama is to take advantage of advances in computer technology and crop simulation studies to predict performance of local crops under different environmental conditions.

At CIAT, Dr. Manrique met with several staff members of the cassava research program. The objective of this trip was to review recent developments on research directed to alleviate soil constraints for cassava production in tropical areas. Particularly impressive was the research conducted in CIAT on nutritional requirements for cassava, soil acidity and Al toxicity related problems, and an ongoing program on screening cassava cultivars with relative tolerance to low available P. Because both Colombia and Panama have soils with similar constraints, there is a potential likelihood that research findings at CIAT can be adapted to Panama conditions.

Dr. Manrique initiated field research aimed to alleviate soil constraints for cassava production in acid infertile soils of Panama. Two experiments with cassava were established in late May at the Ocu research farm station. The first experiment involved the growth of ten local cultivars a high Al saturation Ultisol. The aim was to find genotypes efficient in utilizing nutrients from high percent Al saturation soils. The ultimate goal would be to have a pool of cassava cultivars capable of growing successfully in soils where application of soil amendments may not be feasible. The second experiment on the same soil involved the application of lime rates to reduce Al saturation to a level that cassava yields would be economically feasible. To support data collection on these initial experiments, the soil profile was thoroughly described and sampled. Soil samples were sent to IDIAP's laboratory for physicochemical analyses. A weather station is being established near the experimental plots. Solar radiation, rainfall, temperature and relative humidity will be recorded on a daily basis. Soils and crop data gathering will include periodic soil and plant tissue samplings and recording of phenological events. The overall objective is to collect organized information that would help to interpret cassava performance.

Continuing with research on the Benchmark soils of Panama, an outline of a Spanish/English technical bulletin on land capabilities on the Benchmark soils of Panama was prepared. This bulletin will

summarize soils, weather and crop data of each Benchmark soil as well as prediction of crop response at different levels of soil amendments. Literature research of previous work done on soils and crops as well as weather data collection are in progress. In May, soil profiles of four additional Benchmark soils (Rio Hato, Aguadulce, La Mesa and Ocu) have been described and sampled. Soil samples will be sent to the USDA Laboratory in Lincoln, Nebraska for physical and chemical characterization.

Dr. Manrique organized a field day on techniques for soil sampling and soil profile description for classification purposes. The objective of this field day was to continue with the effort of disseminating Soil Taxonomy as a basic tool for soil survey studies. The field day was conducted at the Calabacito Farm Station with the assistance of Mr. Jaramillo. Most MIDA irrigation engineers and a few IDIAP staff attended this field day.

Dr. Alfredo Serrano, Animal Reproduction Specialist

I. GENERAL CONSIDERATIONS

During his initial three month residence in Panama City, Dr. Serrano familiarized himself with the investigation projects of IDIAP. In addition, he made numerous visits to the Central Provinces in order to establish priorities for his work plan.

In the Eastern Region (Chepo), he analyzed the current problems found in dual purpose cattle and organized two technological transfer meetings.

The second week in April, the Animal Production Specialist took up residence in Santiago where he initiated his work with special emphasis on the Central Provinces.

II. SPECIFIC AREAS OF ACTIVITY

1. Diagnosis of and Prevention of Diseases with the Greatest Economical Importance.

1.1 Background

The dairy, beef and dual purpose herds are characterized by low productivity. Low productivity values are the result of low reproductive efficiency which, in its turn, leads to the slaughter of cows and precludes the improvement of cattle in Panama. Very little information and statistics exist on the reproductive disorders and the causes of the slaughter of cows in Panama's slaughterhouses.

1.2 Progress

Dr. Serrano initiated a research project with the collaboration of the Animal Health Program of MIDA. The principle objective of this investigation is to study the causes and effects of infertility in cattle in the Azuero Peninsula.

The strategy for this investigation was modified due to the lack of necessary resources and because it was considered more timely to initiate investigations at the level of the slaughterhouse in order to study:

- 1) incidents and causes which lead to the slaughter of cows capable of reproduction;
- 2) identification of reproductive disorders and infectious diseases.

To date, the compiled information has resulted more interesting than expected. Statistically, it was discovered that the average number of animals slaughtered annually in the Santiago slaughterhouse is

44,064 (Ministry of Health 1932-33). From this total, an annual average of 14,551 cows are slaughtered, representing thirty-three percent of the total number of animals slaughtered. Ninety percent of the slaughtered cows comes from the Provinces of Veraguas, Los Santos and Coclé.

Analyzing such information, one must ask various questions. Is the annual slaughter of 14,551 cows in the Azuero Peninsula justifiable? With the indiscriminate slaughter of animals, how can a reproduction program progress? And how can one increase calving rates, replacement rates and other parameters?

Below is presented a table with the initial results corresponding to 301 out of the 2,000 cases to be studied. Thereafter follows the analysis of collected samples and the identification of problem farms.

IDENTIFICATION	NO. CASES	%
Reproductive tracts studied	301	
1. Pregnant cows	218	72.4
Pregnancies of 15-90 days	110	50.4
Pregnancies of 91-180 days	56	25.6
Pregnancies of more than 181 days	52	23.8
2. Non-pregnant cows	83	27.6
Non-pregnant normal	51	61.4
Non-pregnant abnormal	32	38.6
Granular vaginitis	90	30.0
Catharral vaginitis	4	1.3
Abnormal cervix	8	2.5
Cervicitis	3	1.0
Metritis	12	4.0
Piometra	3	1.0
Atrophic ovaries	4	1.3
Hypoplastic ovaries	3	1.0
Static ovaries	16	5.6
Ovaries with growing follicles (F1,2)	80	26.5
Follicle cysts	3	1.0
Luteal cysts	3	1.0
Persistency of Corpus Luteum	22	7.3
Salpingitis	4	1.3
Mummified Fetus	2	.6
Others	12	--

F1,2 = Follicles of 10-20 mm.

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Analyzing the information in the above chart, we can see that 72.4 percent of the cows slaughtered in the Santiago slaughterhouse were fertile and were pregnant. In other terms, 10,500 fetuses are slaughtered annually, drastically affecting the replacement rate and animal breeding programs in the Central Provinces.

The more common disorders which affect cow fertility are apparently related to ovarian inactivity. This is very common in the presence of ovarian follicles in different stages of growth as well as the persistency of the corpus luteum. These two deficiencies are very possibly the result of inadequate nutrition; lacking in energy, minerals and proteins.

1.3 Future Plans

A total of 2,000 cases will be studied. Laboratory studies will be made on the collection of blood, urine, secretion and tissue samples. Problem farms will be identified and an evaluation of its system of management will be made. Once the causes which affect cow reproductive efficiency in the Central Provinces have been identified, a preventive herd health program will be formulated jointly with MIDA and the Ministry of Health.

2. Calf Raising on Dual Purpose Farms

2.1 Background

Calf raising in the tropics has presented many problems due to the different factors which affect growth and animal health. The annual calf mortality in Veraguas reaches 9.8 percent which is a little more than the national average. In these cases, the calves die as the result of a lack of proper management and from limited nursing. Stylosanthes capitata is a legume which has been adapted to the soils of Galabacito, IDIAP's experimental farm, and it has shown itself to be a very promising nutrient for calf raising. Digitaria swazilandensis a grass, well-known by the country's farmers, has been grown satisfactorily on Galabacito. These two species used in rotation grazing provide a good alternative to improve the calf raising and to control high mortality.

2.2 Progress

A project has been designed for calf raising on dual purpose farms with rotation grazing on pastures of Digitaria swazilandensis and Stylosanthes capitata. A half hectare has been selected for this study. It is located contiguous to the barn and preparation of the soil has already begun. The trial will begin once the pasture has been established and once the new-born calves are available.

2.3 Future Plans

Once the calf raising study has been established, an alternative to early weaning and its effect on cow fertility will be studied. It

is of great importance to investigate an alternative method to improve the management of the replacements. The results obtained from these studies will be applied to collaborating farms of IDIAP.

3. Training

3.1 Background and Progress

Continuing with the training program initiated in the Eastern Region, two events were organized in the current trimester. The first of these was a seminar on the identification of reproductive disorders in cattle. The seminar was given in the Santiago slaughterhouse and ten professionals from IDIAP and the Ministry of Health assisted.

The second training event was a workshop on herd reproductive efficiency with special emphases on reproductive evaluation of bulls. The seminar was of a practical nature and the training was realized on the Galabacito farm and in the INA-MIDA installations. Twelve professionals from IDIAP, MIDA, the Ministry of Health, the Panama National Bank and INA assisted.

3.2 Future plans

To carry out the training programs planned, a visit will be made to the experimental station at Gualaca and a workshop will be programmed on the different aspects of management. If feasible, a seminar at the national level will be organized and specialists in animal nutrition, management, pastures and animal health will be invited.

4. Other Activities

The Animal Production Specialist was invited by the director of IDIAP to assist at a meeting in Panama City with Dr. Lars-Erik Edquist, on radio immunoanalysis and its application to the investigation of reproductive disorders in cattle.

Dr. Serrano also participated in a meeting in Panama City, organized by the Director of IICA, on cooperative projects in animal health with special emphasis on reproduction. Professionals from MIDA and the regional coordinators from the IICA Health Program also assisted.

Dr. Serrano assisted at the Tenth International Congress on Animal Reproduction and Artificial Insemination held at the University of Illinois. He presented the results of his investigations of the criteria by which to evaluate bull fertility in the Central American Isthmus.

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