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REPORT ON
SHORT-TERM STAFF ASSIGNMENT

Submitted by
PROF. EDWARD D. CARTER
Department of Agronomy
Waite Agricultural Research Institute
The University of Adelaide
Glen Osmond, South Australia

April 23-June 4, 1984

PORTUGAL UNIVERSITY INSTITUTES DEVELOPMENT PROJECT
(AID Contract--AID/NE-C-1701)
and
UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF INTERNATIONAL COOPERATION AND DEVELOPMENT

REPORT ON
SHORT TERM STAFF ASSIGNMENT
at the
Universidade de Evora, Evora
Instituto Universitario
de
Tras-os-Montes e Alto Douro, Vila Real
and
USDA/OICD PROCALFER PROGRAM, Lisbon and Oeiras
April 23 - June 4, 1984

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EDWARD D. CARTER
Department of Agronomy
Waite Agricultural Research Institute
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PREFACE

This report on my 1984 short-term assignment under the Purdue University Portugal University Institutes Development Project and the USDA/OICD PROCALFER Program builds on foundations laid during my first two assignments, viz; May 8 - June 6, 1982 and April 15 - May 16, 1983, and the reports on these visits.

The background and terms of reference for the 1984 assignment are shown in Appendices A1-A3. I was given permission to be absent from my University during the period April 23 to June 4, 1984 and my program of work and itinerary in Portugal is detailed in Appendices B1-B3. Once again, there was a heavy load of field and laboratory visiting and consultations with many individuals and groups in Portugal, not only in the Alentejo (principally at the University of Evora) but also at the Instituto Universitario de Tras-os-Montes e Alto Douro at Vila Real and surrounding districts. Furthermore, I spent a period of some seven days on matters directly related to the PROCALFER program: meetings, seminars and associated field visiting. This extensive travel gave me a clear picture of the existing and potential land use and some of the related agronomic, economic and social problems of these regions of Portugal. There is overwhelming evidence of the potential to improve production of pastures and forage crops.

Definitions of pasture, rangeland, forage crop and fodder were given in the report on the 1982 assignment and will not be repeated here.

The main emphasis of the 1984 assignment was:

(i) to encourage interest in and promote greater awareness of the potential to increase the quantity and quality of pastures and forage crops with particular emphasis on the role of annual legume species;

(ii) to indicate the importance of surveying existing pastures to determine the level of legume seed reserves;

(iii) to show the potential advantages of upgrading these existing native and natural pastures by sowing additional legume seeds and the various sowing options available e.g. direct drilling dry or after the first rains and the importance of ensuring good seed coverage;

(iv) to stress the importance of proper grazing management in both the green and dry pasture stages. There must be a compromise between ensuring reasonable levels of pasture utilization and the hazards of depleting the legume seed supply by allowing excessive consumption by sheep; and

(v) to indicate some of the standard research and development techniques used to improve the quantity and quality of pastures and forage crops with the emphasis on maximising benefits and minimising costs.

My thanks are due to the many people in Portugal who helped me to fulfil my mission and to make my stay both useful and enjoyable. I am most grateful to all those persons listed in the Itinerary (Appendix B3), and any who may have been inadvertently omitted, who gave of their time and knowledge.

I am especially grateful to the following three groups:

(i) Professor Ario Lobo Azevedo, Rector of the University of Evora, for his help and encouragement; Eng. Pedro Silveira and his wife Carmo for arranging much of the detailed itinerary and for their guidance and friendship at Evora and elsewhere; Eng. Pedro Vacas Carvalho, Dr. Afonso de Almeida and Dr. Manuel Cancela d'Abreu.

(ii) Professor Doctor Fernando Nunes Ferreira Real, Rector of IUTAD; Professor Doctor Joaquim Lima Pereira, Vice Rector of IUTAD; Professor Jose Pereira, coordinator of the USAID/Purdue program at IUTAD and Eng. Nuno Moreira who arranged the detailed program in northern Portugal.

(iii) Dr. James Black, USDA/OICD coordinator at Oieras; Eng. Almeida Alves, Director-Coordinator of PROCALFER; Eng. Andre Dordio, National Agronomy Station Coordinator of PROCALFER.

Finally, it is a pleasure to record my thanks to the US AID Mission in Lisbon and to Purdue University and USDA/OICD for providing financial assistance to enable me to undertake this assignment in Portugal which is so closely related to my research and teaching at The University of Adelaide in South Australia.

Edward D. Carter

EDWARD D. CARTER

Department of Agronomy
Waite Agricultural Research Institute

15/12/84

I. SOME GENERAL COMMENTS ON THE 1984 ASSIGNMENT

1. The University of Evora: The program of visiting embraced individual and group discussion of existing and planned research programs of various members of staff in the Plant Sciences, Animal Sciences and Geosciences Departments, along with field inspections of ongoing research programs. Nearly two days were devoted to leading seminars/discussions involving both staff and students on various aspects of the ecology, production, management and utilization of pastures and forage crops. Special emphasis was placed on methods of measuring yield and botanical composition of pastures including the use of the Levy Point Quadrat.

Opportunity was taken to see progress on the University farms - Mitra, Almo Creva, Daroeira and Outeiro, as well as revisiting several private farms to see progress in the pasture livestock sector. These visits again confirmed the generally poor state of pastures but a large potential to improve the quantity and quality of livestock feed by attention to sowing additional subterranean clover, serradella and some other legumes (refer to the 1982 and 1983 reports Purdue University (IE&R/IPIA) by E.D. Carter).

One matter of grave concern is the inadequacy of space for practical classes in such subjects as soil science and agronomy. Partly as a consequence of lack of space and partly by tradition students do not get enough "hands-on" experience using laboratory equipment and actually collecting and processing data. Multiple repetition of classes (up to 5 and 6 times) is a soul-destroying process and considerably restricts the research activities of young staff members who are obliged to obtain higher degree qualifications.

It is essential that every effort be made to ensure that undergraduate students get some introduction to research by having class experiments before their own thesis research. For example, a simple density experiment with subterranean clover sowing rates of 1,2,4,8,16,32,64,128,256,512,1024 kg/ha. Another very useful student experiment involves using a range of densities of wheat with and without added nitrogen in which the interrelations of wheat plant numbers, tiller number and associated weed growth are studied.

As mentioned in a previous report it is essential to get plant and animal science students into the field to survey existing native, natural and sown pastures and to get data on yield and botanical composition of these pastures (Plate 1). It is very important that students get to know the local agricultural problems: if students (along with a staff member or members) can demonstrate cheap and effective methods of improving productivity of pastures it greatly enhances their own standing in the community and improves the image of a rural University. This is a very important exercise in public relations.

Successful field research on pastures and forages requires laboratory facilities as proposed during the assignment and later detailed to embrace soil, plant and animal research facilities (Figure 1).

With regard to the EIPO experiment, my recommendation is to retain half the experiment nearest to the farm buildings for the purposes of research, teaching and extension purposes. In August-September this area, extending back to treatments 12C and 12CT (adjacent to the guard's camp), should be sampled for total seed reserves prior to re-sowing a mixture of subterranean clovers. Other detailed recommendations have been given to Eng. Pedro Silveiro and Eng. Jose Avo.

2. IUTAD, Vila Real: The program of visiting embraced individual and group discussions of existing and planned research programs of various members of staff in the Plant Sciences, Animal Sciences and Geosciences along with field, animal house and laboratory inspections of ongoing research programs. Approximately one day in total was spent on leading seminars/discussions involving both staff and students in various aspects of the ecology, production, management and utilization of pastures and forage crops. Again, as at the University of Evora, special emphasis was placed on the methods of measuring yield and botanical composition of pastures including the use of the Levy Point Quadrat.

The staff at Vila Real are predominantly young and very enthusiastic. In 1984 the physical facilities and equipment available for research in the soil-plant-animal sciences is vastly superior to that available at Evora. The fact that research facilities are superior, and also that there are less social pressures beckoning staff to Lisbon than is the case with their colleagues at Evora means that research output tends to be higher at IUTAD than at Evora. Furthermore, IUTAD does not have the great diversity of courses as is the case at Evora. Again this helps IUTAD to maintain focus on important rural research topics.

3. PROCALFER: In excess of seven days was spent on matters directly related to the PROCALFER program in Portugal. Field visits in both northern Portugal and in the Alentejo were made to assess the quality and relevance of some projects. Regrettably some projects did not give value for money expended and a more rigorous evaluation and culling of the projects is needed. For example, near Vale Formosa one experiment designed to assess grazing management had been fenced at great cost yet after three sowings there was quite insufficient growth of pasture to start such an experiment. The facts are that in these districts of marginal rainfall, undulating skeletal soils of poor fertility and infiltration the limiting factor is pasture establishment and productivity - not management of the feed supply. This is just one example of many in Portugal where there are large grazing experiments planned without having the basis of an assured pasture. In other words; what is needed is to first assess a range of early-maturing cultivars of subterranean clover along with other species e.g. *Trifolium balansae*, *T. resupinatum*, *T. glomeratum* etc. to first get a good pasture growing.

So far as grazed pastures based on annual self-regenerating legumes are concerned there is ample evidence in southern Australia that the only management of significance relates to green pasture grazing to ensure seed set and dry pasture grazing to ensure that the seed supply is not over-depleted. The best management of these pastures based on subterranean clover (or annual medics) is as follows:

(i) Continuously graze after break of season and ideally maintain the sward at about 5-7.5cm high. This allows adequate light penetration to encourage flowering and maximum seed set. It may be desirable to reduce grazing pressure after commencement of flowering to ensure maximum seed set in those cases where there is an insufficient seed reserve (Carter, 1981, 1982).

(ii) After maturity of the seed it is necessary to remove the top growth by grazing to avoid damage by 'blanketing' should summer rains arrive unexpectedly. However, there must be a compromise between removal of dry herbage and consumption of clover burrs or medic pods because almost 100% of subterranean clover seed is destroyed following ingestion by sheep and in the case of the annual medics generally only about 1 to 2% of the seed remains viable after passage through the sheep (Carter 1980).

The most concentrated part of the PROCALFER assignment was my presentation of 12 seminar/discussion sessions over the period of three days May 22-24 at the Plant Improvement Station at Elvas. A set of 49 sheets of information and data also references for further reading was given to all participants at the course. (Copies of these sheets along with other draft report material were left with Jose Luis Pinheiro at the USAID office in Lisbon).

4. General: In previous reports on Portugal (Carter 1982, 1983) the constraints to agricultural production and the priorities in agricultural research have been detailed. These major problems occur over all of Portugal but, of course, the relative ranking of problems and constraints varies from one ecological zone to another. There is no possibility of elaborating on all of these problems and constraints to agricultural research and development and agricultural production in Portugal in this brief report but a few important topics have been mentioned briefly in Chapters II,III,IV and V and these priority subjects were discussed with many individuals and groups (especially at seminars at Evora and Vila Real and at the PROCALFER Workshop at Elvas). Furthermore, several of these topics have been addressed in detail in previous reports.

The major agricultural problems of Portugal in 1984 were seen to be:

(i) Tillage and seed-bed preparation : methods and costs.
(ii) Crop and pasture establishment : sowing methods and costs.
(iii) Choice of pasture and forage crop species, cultivars, mixtures and sowing rates for the various ecological zones : benefit/cost ratios.
(iv) Inoculation requirements of crop and pasture legumes, especially in the colder, elevated areas of Northern Portugal, e.g. some of 'baldios' areas.
(v) Fertilizer and lime requirements for pasture establishment and maintenance.
(vi) Weed control by grazing, tillage and herbicides.
(vii) Grazing management of annual pastures : green stage and dry stage.
(viii) Crop rotations with and without a self-regenerating pasture legume or leguminous forage crop, or food legume. (Recent wheat subsidies have been a major disincentive to either pasture improvement or use of pasture legumes in rotations).
(ix) Haymaking: the need for earlier cutting to improve quality. The problems of inadequate soil levelling and unsuitable machinery.
(x) Insufficient research and extension officers trained with a broad understanding of crop-pasture-livestock integrated farming systems.
(xi) Insufficient research money, facilities and research workers in the main agricultural areas, especially in Northern Portugal.
(xii) Inadequate coordination of existing agricultural research efforts of the various groups. There is an urgent need to define research priorities and allocate people and financial resources to solving those problems.

PLATE 1

Pasture surveys will greatly help to define the areas of native and natural pastures that have potential for cheap and easy development.

Upper: Using the Levy Point Quadrat

Lower: (L) Taking soil core samples with Coile sampler, the first stage in assessing legume seed reserves.

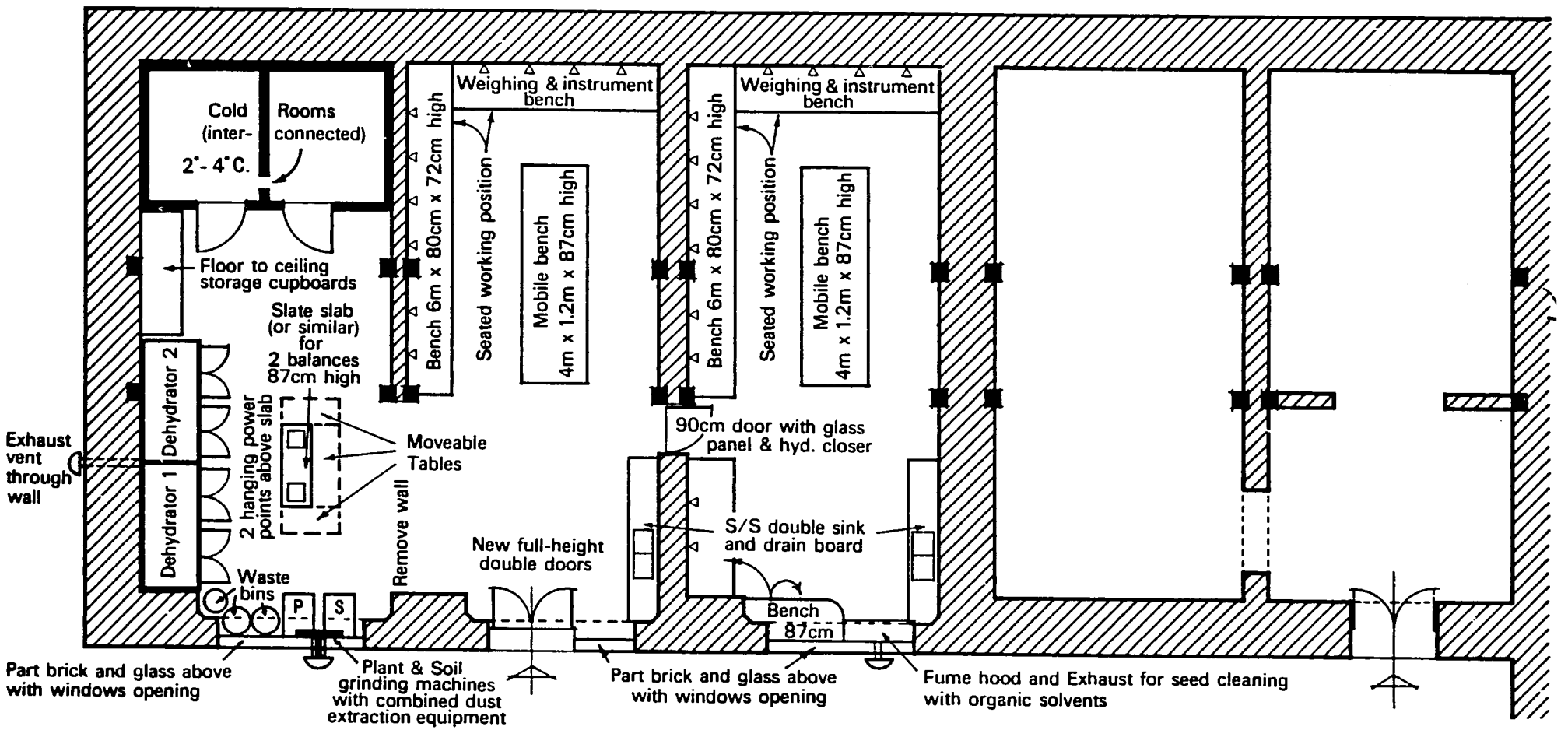
(R) Harvesting annual pasture from a 0.1 m^2 quadrat.

FIGURE 1

Plan of redevelopment of garage area at Mitra for handling and processing soil-plant-animal samples from research programs.

UNIVERSITY OF EVORA, PORTUGAL

REDEVELOPMENT OF GARAGE AREA AT MITRA FOR HANDLING AND PROCESSING SOIL-PLANT-ANIMAL SAMPLES FROM RESEARCH PROGRAMS.



△ = Single-phase power points. Note that cold rooms and dehydrators need 3-phase power.

E. D. Carter, December 1984 Scale 1 : 100

II. TILLAGE METHOD, SEEDBED PREPARATION AND CROP ROTATION EXPERIMENTS

In crop rotation experiments it is most important to not only be able to distinguish between factors like tillage methods, seedbed preparation and weed control but also to ensure that all treatments are represented in all years to properly assess seasonal influences.

In existing farming systems involving rotation of cereal crops with volunteer pasture (pousio) and worked fallow (alqueive), tillage method is completely confounded with weed control, possible improved infiltration, possible water storage and also mineralization of organic matter to give increased levels of available nitrogen, phosphorus and sulphur. Furthermore the traditional depths of tillage during the period of the alqueive is in fact drying the soil. All that is needed is a shallow cultivation to give a surface mulch.
What is not generally recognized is that weeds can be controlled with well-timed shallow tillage (8-10cm) with disc plough, disc harrow or scarifier at a fraction of the cost of deep ploughing (commonly 30-40cm). However, almost all the scarifiers used in Portugal have narrow points (often 5.0cm wide designed as deep tillers) with only about 25% effective soil coverage for weed control, whereas the standard scarifiers used by Australian farmers have interchangeable points of 10cm, 15cm, 20cm or more width, depending on tyne spacing, to give a soil coverage of 100% - 150% for effective weed kill.

In rotation experiments it is essential to distinguish between tillage methods and seedbed preparation, weed control, and variation due to seasons (mainly rainfall) and in most cases it is better to look at tillage method/seed-bed preparation and sowing method/time of sowing (i.e. mainly physical factors) of various crops quite separately from crop/pasture rotations which inevitably involve dynamic biological components such as weeds, pests, diseases, biological nitrogen fixation, etc. (i.e. mainly biological factors).

The rotation experiment at Herdade do Mitra (University of Evora), while useful for observation purposes, suffers from the fact that its large size in itself, leads to confounding influences as all treatments cannot be completed within a small time period (e.g. one working day). Furthermore, there is a good deal of variation in soil type, soil depth, incidence of granite outcrops and density of oak and other trees which all help to obscure the results. The actual timing of operations within a season, and markedly differing seasonal conditions from one year to the next, inevitably confound the results. Thus this experiment should be treated more as a comparison of three farming systems.

A very large number of soil samples will be needed to satisfactorily characterise the various treatments : all paddocks need to be divided into 10 notional strata to cover variation in topography, soils, etc. and at least 10 sites per stratumare needed for taking soil samples. Of course, these within-stratum soil samples can be bulked and subsampled to give say two samples per stratum or twenty samples per paddock to take to the laboratory for air-drying, sieving to determine fine earth fraction ($\leqslant$ 2mm) and further grinding (say 1 mm) for chemical analysis - total N, organic carbon, pH etc. Separate sub-samples will need to be taken from each stratum if aggregation and soil porosity are to be studied. Furthermore, it is essential that accurate measures of bulk density be taken in the field with a Coile sampler (Coile 1936) or similar device to enable extrapolation of laboratory analyses to the field situation.

For example, 1% N in the top 10cm of a clay (barros) soil will represent a greater amount of nitrogen per hectare than in the case of a gravelly granitic soil.

In undisturbed grazed leguminous pastures in Mediterranean pasture conditions most of the change in fertility is in the top 10cm of soil with a marked decline in nitrogen and carbon from the surface to 10cm depth. However, in any deep-ploughed treatments of rotation experiments this picture will be distorted. Decisions on soil sampling and laboratory analyses must be made after very careful consideration as a great deal of work on soil analyses may be quite unrewarding.

Experiments to evaluate tillage and seedbed preparation methods or the merits of various crop rotations are best arranged in a randomised block design with or without a split-plot component for main treatments (e.g. sown pasture or pousio) on a compact area as uniform as practicable. Individual sub-plots can be based on single drill strips of 2 to 4 metres width and 20 to 40 metres long (e.g. plots of wheat or oats). Sub-sub-plots can be superimposed on the sub-plots (e.g., various levels of nitrogen). Having these experiments on a relatively small area of land will ensure:

(1) greater uniformity of soil on the experiment site;
(2) that all operations (tillage, sowing, harvesting, etc.) are completed in a working day to avoid disruption and consequent bias through rain;
(3) that all treatments are represented each year to avoid confounding influences due to differing seasons.

In rotation experiments the role of pasture (native/natural or sown) can be assessed in terms of yield, botanical composition, levels of protein and *in vitro* digestibility. These plots can be grazed by sheep from time to time to control weeds and return nutrients to the soil. Temporary fencing of these plots will be needed (200m rolls of 6-line sheep fence as made by Boral-Cyclone fixed in position with wooden stakes or metal fence droppers are ideal for temporary fencing).

There is absolutely no merit in complicating a rotation experiment with a superimposed stocking rate experiment. In experiments involving tillage metho crop rotation, etc. there needs to be a clear statement of objectives and a sound design to give clear answers at minimum cost and as quickly as possible. No experiment can realistically simulate the dynamic agricultural farm situation which varies with market forces. Hence long-term rotation experiments covering large areas may usefully be replaced by shorter-term and more rewarding rotation experiments which critically examine specific problems e.g. changes in chemical/physical fertility, yield of crop etc. Above all, it is essential to examine the <u>ecological or biological possibility</u> or potential for production of various species in a given environment: this may be a relatively static situation. On the other hand, the <u>economic practicability</u> of achieving the biologically-possible yield is quite dynamic depending on cost of inputs and price of products. It is the responsibility of the research worker to generate a range of options of input/output relations to suit the various landholders. Good field experiments must be amenable to both statistical and economic analyses (Carter 1975, 1978).

Detailed discussions on existing and planned tillage and rotation experiments were held with Eng. Pedro Silveira, Eng. Mario de Carvalho and Gottlieb Basch a Ph.D student funded under the GTZ aid program (Figures 2 and 3).

FIGURE 2

Suggested tillage experiment for University of Evora farms.

SUGGESTED TILLAGE EXPERIMENT FOR UNIVERSITY OF EVORA FARMS, 1984-87

(Preliminary Draft)

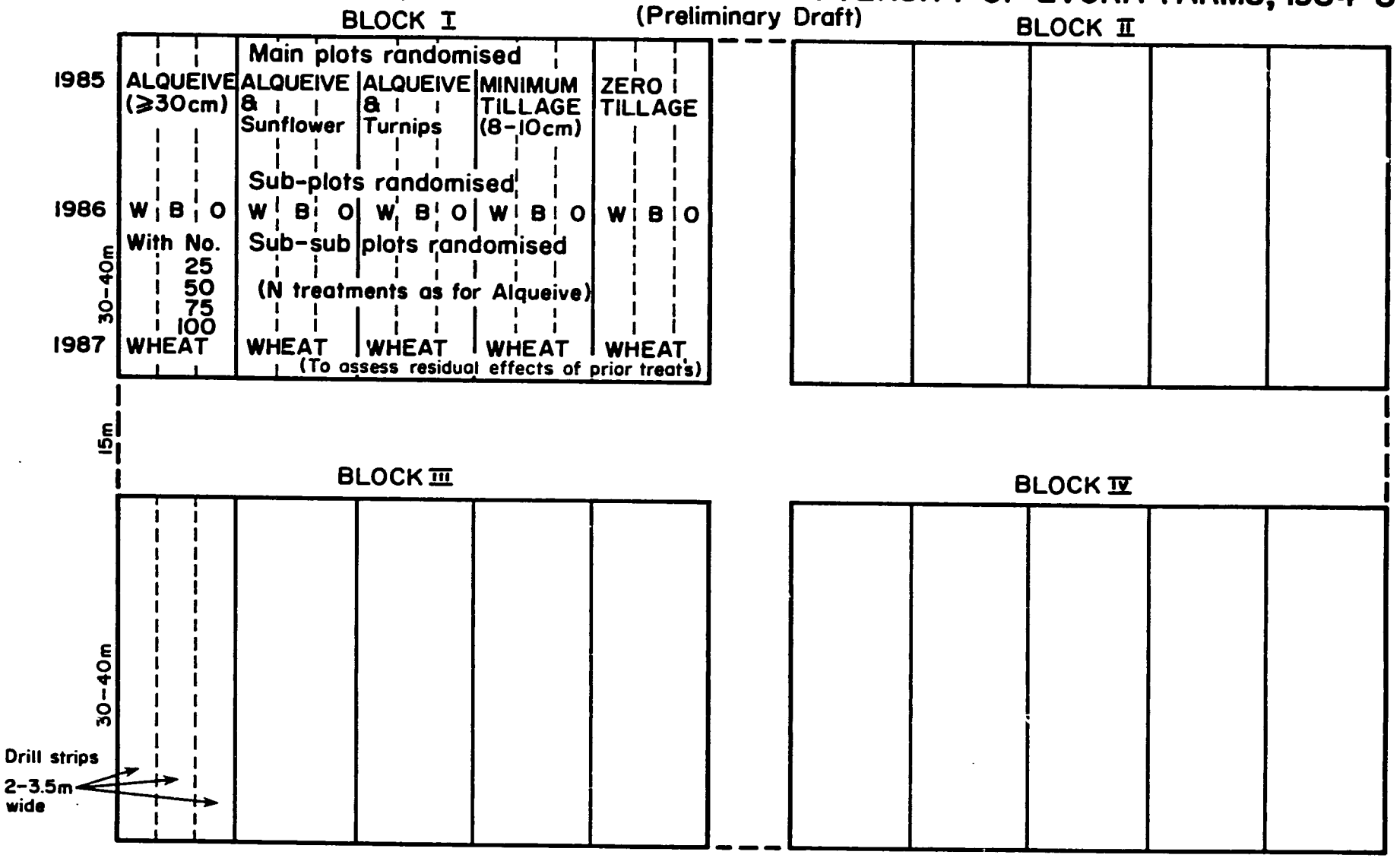
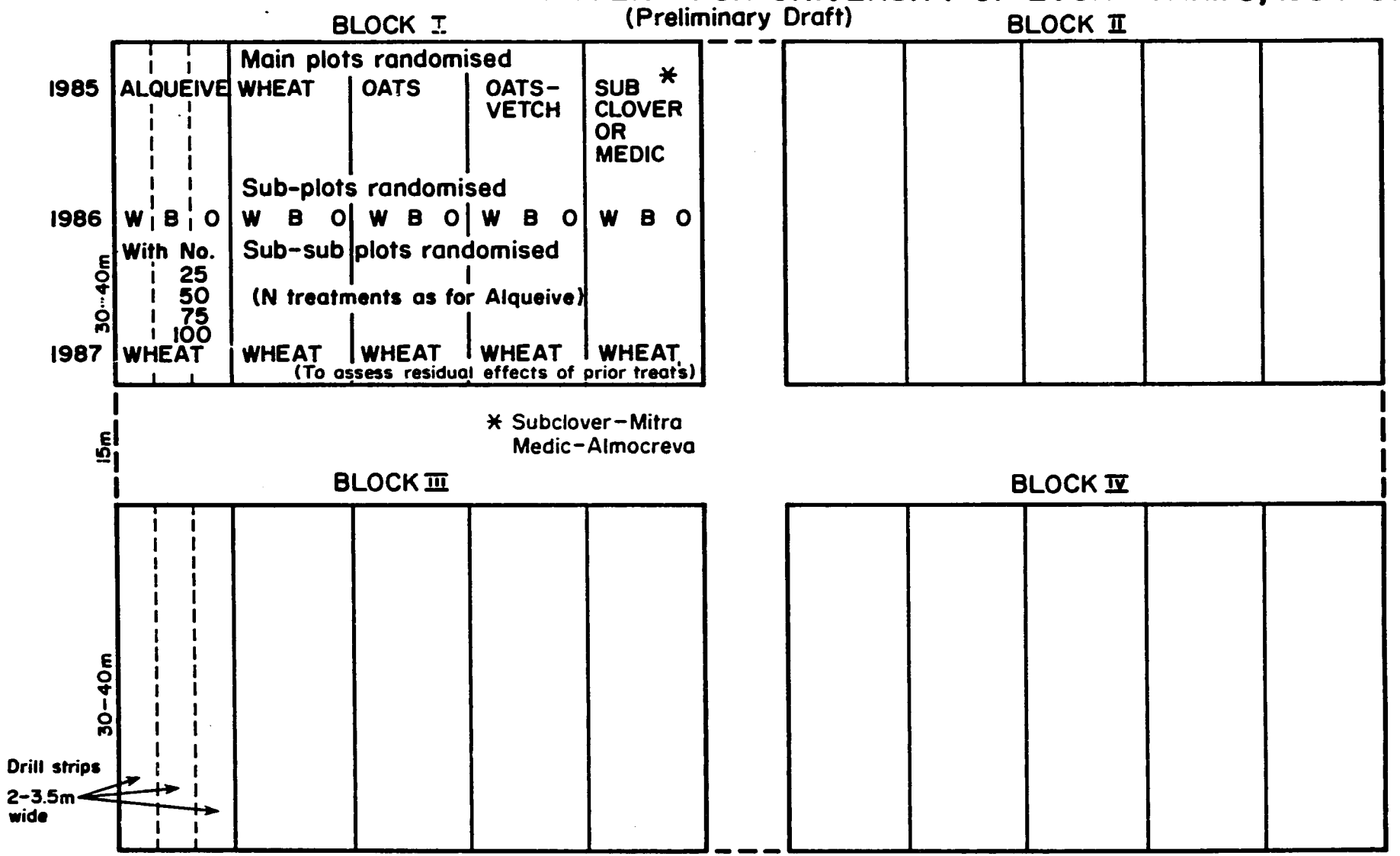


FIGURE 3

Suggested rotation experiment for University of Evora farms.

SUGGESTED ROTATION EXPERIMENT FOR UNIVERSITY OF EVORA FARMS, 1984-87

(Preliminary Draft)



Note: Selection of sites and machinery in 1984. Proposed alqueive is shallow (minimum tillage) as for all five main treatments. Main plots to comprise 3 drill widths (Wheel on Wheel) of 12 to 15 rows spaced at 15 to 18 cm.

III. FERTILIZER NEEDS OF CROPS AND PASTURES

As far as can be determined no organization or individual is seriously tackling the urgent problem of research and development of assessing the real needs (biological response/economic return) of the various macro-nutrients N,P,K,S,Ca etc. of crops or pastures in terms of initial and maintenance requirements. While excellent work was done by Eng Almeida Alves (INIAER,Oeiras) in earlier years this has not been followed up.

So far as the micro-nutrient requirements are concerned there is ample evidence of apparent symptoms of deficiency of molybdenum, copper, zinc, manganese and boron in subterranean and other clovers in the field. Although Eng. Sequeira (INIER Oeiras) has made some progress with pot culture studies these at best, are only a guide to likely field responses. There is urgent need for a concerted attack on the initial and possible maintenance requirements of micro-nutrients for various crops and pastures in the main edapho-ecological zones of Portugal.

These studies must include studies to resolve confusion between lime and indirect molybdenum response and the real needs of lime for nodulation and early establishment of legume and non-legume species. In other words how much lime is needed to change soil pH sufficiently for various crops and pastures, how deeply need this lime be incorporated in the soil and how little can be applied in rows with legume seed to give proper nodulation of legumes and establishment of both legumes and non-legumes. For example lucerne (*Medicago sativa*) is established on poorly-buffered deep acid sands in South Australia by sowing the inoculated lime-pelleted seed with 200kg of lime in rows while the fertilizer (single superphosphate 200kg/ha, copper sulphate 8kg/ha, zinc sulphate 8kg/ha, cobalt sulphate 600g/ha molybdenum trioxide 150g/ha) is sown in separate rows from the seed or broadcast as a separate operation. On acid soils, especially sandy soils, there is always a risk of fertilizer toxicity depressing germination and emergence of pasture and crop species and the nodulation of legumes when seed is sown in close proximity to fertilizer, especially when there is insufficient moisture for rapid germination and emergence (Carter and Saunders 1970).

Some suggestions for layout of field experiments to examine fertilizer requirements of Portuguese soils were discussed in detail with Francisco Garcia and Goncalves Ferreira of the University of Evora. Field experiments require five essential features:

Firstly the site must be representative.

Secondly it must be readily accessible in all weather conditions for seeing and sampling - sampling needs to be early to show best differences as often competition for light and/or moisture by late spring will obscure potential yield differences due to nutrients.

Thirdly the area must be under the complete control of the experimenter.

Fourthly the area needs to be fenced (lightweight temporary roll-fence of 6-row Cyclone is ideal) to exclude unwanted grazing by sheep, cattle and goats.

Fifthly all field experiments need to be laid out in a randomised block design (with or without split-plot arrangement perhaps with main plots, sub-plots and sub-sub-plots). Several fertilizer, grazing management and stocking rate experiments have been seen in Portugal where there has

been replication but no statistical blocks. Replication is no substitute for proper randomised block design where variation due to site variation can be removed by the "Block Effect" in the Analysis of Variance. For maximum precision the Blocks should be as square as possible and treatments within blocks of elongate shape to sample variation in the site to the maximum extent. On slopes the experiments should have treatments running up and down the slope which unfortunately may be incompatible with best soil conservation procedures, but essential to sample the site adequately and to prevent contamination of a lower treatment with an up-slope treatment. In such experiments some strategically placed contour furrows at the lower side of each Block or series of Blocks can minimise any erosion hazards.

The current practice in Portugal of replicating field experiments without using statistical Blocks should cease forthwith.

Pasture and Forage Crop Production

While some data exists on potential productivity of some forage crops there is little or no data on potential productivity of grazed pastures in Portugal. Clearly, this information is basic to a proper estimation of possible year-round carrying capacity and potential stocking rates.

Existing stocking-rate experiments at Mitra, Evora and at Vale Formosa are providing some data on yield and botanical composition but occasional samples from two or three cages per treatment, especially when these cages shade the pasture, are not sufficient to generate accurate data. Despite some imperfections the open and closed quadrat technique (Carter 1983) should be used, samples being taken to ground level in the case of annual species and as near as practicable to ground level with perennial species. Sample size can be small, taking one or more small cores then perhaps 0.05 to 0.10 m^2 quadrats grading up to 0.25, 0.50 or 1.00 m^2 as the season progresses and the height of pasture increases.

In all large field experiments, especially grazing experiments, or where sequential data is being collected on yield of grazed native or natural pastures it is essential to divide all treatments or observation areas into notional strata, for all sampling of soils, pasture yields etc. to minimise sampling errors due to site variation. In most field experiments from 5 to 10 strata within treatments are sufficient. Samples from the various strata may be bulked to minimise work involved in subsequent drying, weighing, hand separation, chemical analyses, etc. However, it should always be remembered that more smaller samples are preferable to fewer larger samples: this applies to all experiments - the only proviso being that in sampling herbage from pasture experiments the edge-error associated with cutting quadrat samples may increase if sampling areas are too small. Core samples of various sizes are most useful for measuring seed reserves in the surface soil and for checking plant emergence/early yield in pasture experiments especially when weather conditions are poor for field work in winter: samples can be taken rapidly and transferred to the laboratory for counting, measuring yield, extracting seed, etc. (Carter, Challis and Ridgway 1977).

IV. SOME COMMENTS ON AGRICULTURAL RESEARCH AND DEVELOPMENT IN NORTH EASTERN PORTUGAL WITH SPECIAL REFERENCE TO THE PASTURE-LIVESTOCK SECTOR

The IUTAD staff is mainly young and most enthusiastic though the lack of experience in many agricultural methodologies makes it highly desirable for them to receive some guidance, advice and funding from external sources. Their research facilities are fair to excellent but most have a heavy teaching load - up to 12 student contact hours per week for two semesters i.e. some 300 hours per year. In view of the fact that academic staff are obliged to complete a Ph.D in a few years means that there is an inevitable conflict of interest between research for their degree and research of specific relevance to North-East Portugal.

Unfortunately the National Agricultural Research Institute (INIAER) has negligible representation in the North; there being a disproportionate concentration of research staff, finance and facilities at Oeiras and Fonte Boa. If fair emphasis is to be given to research and development in the North of Portugal which accounts for the major percentage of export income there needs to be a redistribution of research personnel and funding. So, too, there needs to be a greatly increased input of Government funds into improving the transport infrastructure (especially roads) in the area. The Regional Directorate of the Ministry of Agriculture, Food and Fisheries (MACP) located in Mirandela is well supplied with administrative and clerical staff but has only a few qualified graduates devoted to investigation in the pasture-livestock sector . Most of these are relatively junior and inexperienced staff who are keen to help the agriculture of the region but who suffer from lack of research facilities, and a lack of supervision and training by experienced senior staff. These junior staff are associated with the PROCALFER research and development program administered from the INIAER stations at Oeiras and Elvas and also are associated with IUTAD staff on several World Bank investigations in the pasture-livestock sector.

There is clear evidence of the urgent need for several more experienced research workers in the pasture-livestock sector to lead research teams to help solve urgent field problems related to tillage practice, seedbed preparation, sowing methods for crops and pastures, fertilizer and lime requirements for establishment and maintenance of crops and pastures, choice of pasture and forage crop species, cultivars and mixtures for various locations of the North East of Portugal and to look at the biology and economics of fodder conservation and supplementary feeding for the various local and introduced breeds of sheep, cattle and goats. These many problems must be solved if Portugal is to gain entry to and profit from entry to the European Common Market.

The cooperative work between the staff of IUTAD and the DRTM at Mirandela related to the PROCALFER and World Bank activities is a good beginning but this work needs to accelerate to provide definitive answers and to create and maintain competance and confidence in the farming community if the farmers are to make best use of World Bank credit.

Relocation of some experienced soil, plant and animal research workers from Oeiras and Fonte Boa together with some laboratory facilities to Mirandela could assist the overall research and development program. A minimum initial requirement is a pasture/forage laboratory of approximately 100 m^2 with a cold

room (2°C) of approximately 20 cubic metres capacity, a forced-draft dehydrator of approx. 4 cubic metres capacity capable of drying up to 250kg green herbage in 10 to 12 hours (14 KW, with double doors, sliding trays of Wessburg and Tulander type) and with temperature range from c. 35°C to 105°C, suitable for drying herbage and soil samples; one small laboratory oven approx. half cubic metre capacity max. 105°C, a humidified seed germination cabinet of approx. half cubic metre capacity with range 15-25°C. Two taring-type electronic balances 8 or 10kg cap. x 0.1g for herbage and soil weighing and 500g x 0.001 capacity of Mettler, Sartorius or Sauter type. Sink and drainboard facility, also large benches for sorting herbage will be required.

The Soil/Plant/Animal Seminar series recently initiated at IUTAD is an excellent idea : hopefully it can be extended to cover all disciplines on campus and that DRTM and other relevant Government and private/commercial groups are invited. It is important to have a fixed day, time and place for such seminars.

With limited finance and trained researchers it is essential that priorities in research are agreed and that the research be executed properly. For example, newly-established pasture on steep olive grove and orchard land on Quinta d'Alva at Barca d'Alva looked promising, with average yields estimated at 2t/ha (dry matter). There were no actual data available on potential dry matter production from this district yet it was planned to establish a stocking rate experiment with 3,6 and 9 ewes per hectare. Clearly, it is essential to first resolve problems of choice of species, cultivars, mixtures and sowing rates before undertaking research on grazing management including the impact of stocking rates. It is improbable that a stocking rate experiment will be ever needed in such a situation : stocking rate experiments are very expensive and, if done properly, need a great deal of resources. The alternative - and much cheaper - option is to collect data on pasture and/or forage crop yield. These data scarcely exist in Portugal and such data are needed as the basis of ruminant livestock carrying capacity in all districts. Clearly, collection of dry matter yield data from important sites in Portugal must continue for 10 or 20 years to get realistic mean data, taking into account variation in rainfall. Complex and expensive experiments should be avoided when satisfactory answers can be obtained more cheaply and easily (Carter 1968a, 1968b, 1968c, 1969, 1977; Carter and Day 1970).

V. MEASURING YIELD AND BOTANICAL COMPOSITION OF PASTURES (Calender of Operations : Emphasis on Pasture Legumes)

September: Take core samples 0-5cm to determine legume seed reserves at relevant sites.

Oct.-Dec: Measure legume emergence/establishment/survival using core samplesor small quadrats. These core samples may be used as the first yield data of the season (Carter 1981).

January-May/June: Yield and botanical composition measures on green pasture are essential. Cuts at 4-weekly intervals are satisfactory. Sampling methods depend on stage of growth. Use small quadrats and scissors, scalpels, knives, etc., at early growth stages. Increase quadrat size as growth increases. Levy Point Quadrat* data is very useful when pasture < 10cm in height e.g. under continuous grazing. This LPQ data can indicate yield, botanical composition and percentage bare ground. The latter is most important in grazing experiments.

Hand-separation e.g. into legumes/grasses/other spp. is best for greatest precision and where chemical analyses are to be done on the components of pasture. However, estimates of botanical composition (by 10x10 method) or with LPQ suffice in many situations.

Yields of pasture following drying at c.85°C are best expressed as kg DM/ha (whole numbers).

Monthly samplings using open quadrats through the whole season (green and dry stages) are essential for describing changes in pasture "on offer " and changes in botanical composition under grazing. Cumulative growth obtained by the "open and closed" quadrat method is essential for quantifying potential productivity of various pastures (or forage crops) in differing environments and differing seasons.

On small plot experiments it is a great advantage to have preplaced wire quadrats - e.g. 25x40cm - set in position on a grid pattern immediately following sowing.

On most larger experiments random quadrat samples are taken within a plot being careful to avoid previously-harvested sites. Whether 2 or more samples are combined to reduce work load will depend on the labour force.

Large samples (say 1 m^2 or combined samples which may be say 5 m^2) must be weighed fresh then sub-sampled for botanical composition and oven drying. Most experiments on pastures and forages require only samples of 1 to 4kg green weight for drying to assess a particular treatment. Two sub-samples (e.g. each of 2 to 3kg fresh weight) are often taken for oven drying to act as a check

*See Levy & Madden (1933).

against accuracy of sub-sampling. At the same time one or two smaller samples (500 to 1000g) are taken for hand separation. As the hand separation may extend over several days it is essential that these be in plastic bags and stored at 2° to 4°C in a cold room. Samples for oven drying should go into a forced draught incubator as soon as practicable after sub-sampling to avoid loss of dry matter through respiration.

If large amounts of herbage are removed from grazing experiments it may be necessary to air-dry (make hay) of the unused part of the field samples and return to the respective treatments in the field.

NOTE: Botanical separations and samples for chemical analyses should be confined to the open quadrat samples in grazing experiments.

June/July: Take samples to assess legume seed production from the various treatments in experiments. Above- and below-surface samples of subterranean clover should be quantified separately.

September: Take 0-5cm core samples to assess total seed reserves of legumes as a guide to the need for sowing more legumes in some pasture situations. Check germination of all seeds purchased for sowing new pastures or renovating old pastures.

Animal Evaluation of Pastures

In grazing experiments (where sheep and cattle are confined to treatments as an integral part of the design) then body weight (preferably after overnight fasting) is by far the most important measure.

These measurements with sheep should be made the same day or the day before or after the pasture samples are taken so that body weight response can be directly related to pasture availability. With sheep, the most suitable weigh ing interval is 14 days (to relate to harvest periods every 28 days). With this interval of weighing it is not necessary to fast the animals but they should be weighed as rapidly as possible in the morning in a fixed sequence of treatments. A convenient clockface or beam balance with accuracy of 0.1kg and an efficient sheep weighing cage (Carter 1964) is essential.

Pasture Quality

Small samples of the harvested material (mixed or hand separated) should be dried at a temperature not exceeding 70°C as rapidly as possible, then stored for protein and *in vitro* digestibility determinations.

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APPENDICES

APPENDIX A

Plan of Work for Prof. Edward Carter

UNIVERSIDADE DE EVORA

PLANO DE TRABALHO PARA O

PROF. EDWARD CARTER

1) PROBLEMA QUE SE PRETENDE ESTUDAR

Para a agricultura do Sul de Portugal é indispensável resolver o problema da enorme quantidade de solos menos aptos para a cultura cerealífera e que, ainda hoje e por se não terem conseguido soluções alternativas de interesse económico, se encontram a ela submetidos. A Universidade de Évora pensa que as pastagens permanentes de sequeiro, acompanhadas de adequada intensificação pecuária, devem ser uma solução para tal problema.

2) OBJECTIVO DA VISITA

Não obstante já haver uma certa experiência em pastagens permanentes de sequeiro para solos ácidos à base de trevo subterrâneo os desvios da média sob o ponto de vista climático ocorrido nos últimos três anos tem posto em causa muitas das técnicas culturais e das recomendações que até ao momento mais tem sido divulgadas. Por outro lado, o constante aumento do preço das sementes, da maquinaria e equipamento, dos fertilizantes e correctivos, põe-nos perante novas técnicas culturais alternativas onde esses encargos são minimizados. Também necessitamos urgentemente de conselho sobre pastagens permanentes de sequeiro em solos pouco ácidos a neutros, à base de medicagos anuais os quais são práticamente desconhecidos em Portugal.

3) TRABALHO A REALIZAR E RESULTADOS ESPERADOS

3.1 - No presente ano agrícola realizaram-se já ensaios de sementeira directa (sod-seeding) em trevo subterrâneo, com maior economia de semente, localização de adubos e menores gastos na preparação da cama da semente, utilizando maquinaria adquirida ao abrigo do Acordo com a AID; convinha que pessoa com experiência nesta técnicas observasse o ensaio, o criticasse e desse sugestões para trabalho futuro.

3.2 - Por outro lado, dentro dos sistemas tradicionais de exploração do solo, começaram-se também a introduzir alterações no sentido de reduzir os encargos com a preparação do solo, substituindo as tradicionais lavouras de verão por escarificações pesadas realizadas na Primavera. Estes trabalhos ir-se-ão reflectir nas alturas da Primavera (especialmente na cultura do girassol), e posteriormente na produção de cereais. Pretendiamos estabelecer uma metodo-

logia de recolha de dados que nos permitisse demonstrar o efectivo benefício das alterações propostas no sistema.

3.3 - As Herdades Experimentais da Universidade têm finalmente um estatuto que permite estabelecer objectivos a atingir e define o modo como a investigação departamental pode ser incluida nos planos de exploração das Herdades. Dado que a preparação do plano geral que define os grandes objectivos a atingir nos próximos anos se encontra neste momento em execução, devendo tais metas serem definidas até Julho deste ano, conviria ouvir pessoas com experiência na área de pastagens e forragens em clima mediterrânico de modo a obter criticas e sugestões ao seu conteudo.

3.4 - Dado que o Departamento de Fitotecnia conta actualmente com mais um assistente para a área de Pastagens e Forragens convinha que ele fosse orientado em trabalho de investigação no domínio das pastagens de sequeiro à base de trevo subterrâneo e medicagos anuais, trabalho esse conducente ao seu doutoramento.

4) PERFIL PROFISSIONAL

Pretendemos que o consultor tenha efectiva experiência em pastagens de sequeiro à base de trevo subterrâneo e medicagos anuais em condições de solo e clima mediterranico semelhantes aos do Sul de Portugal. Pelos contactos e pelo trabalho que o Prof. Edward Carter realizou na nossa Universidade nos dois anos em que já foi consultor não temos qualquer duvida de que satisfaz totalmente ao perfil requerido.

CALENDÁRIO DE TRABALHO

Em anexo.

United States Department of Agriculture

Office of International Cooperation and Development

Washington, D.C. 20250

Oeiras, Portugal

To Dr. Edward Carter

February 23, 1984

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From James A. Black
Admin.Coordinator

Subject Scope of Work

Please find attached the scope of work for your consultancy in Portugal during May.

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Scope of Work

Dr. E. Carter

1. To assist the technicians involved on PROCALFER activities to plan different types of trials concerned with:

   a) Improvement of native pastures;
   b) Direct drill cultivated pastures;
   c) Management of pastures;
   d) Sheep grazing.

   This work could be done during the days before the trip to Vila Real.

2. Give a three day seminar (included in the "Forage Course" for specialists) on the following subjects:

   a) Critical analysis of pasture and forage production in Portugal; guidelines to be followed;
   b) Considerations about the system soil/plant/animal;
   c) Experimental methodology to be carried in relation to the requirements of pasture and forage research.

   The seminar will be held in Elvas during the last week of May.

Feb. 20, 1984.

PURDUE UNIVERSITY INTERNATIONAL PROGRAMS IN AGRICULTURE

Office of the Director

March 26, 1984

Mr. Allen Eisenberg
Contract Specialist
AID/CM/ROD, Room 729C, SA-14
Department of State
Washington, DC 20523

REF: Contract AID/NE-1701 -- Portugal University Institutes Development Project

Dear Mr. Eisenberg:

This is Purdue University's formal request for AID/W authorization of the staff appointment and country clearance for DR. EDWARD D. CARTER. The appointment will be in accordance with the terms and conditions of the above referenced contract.

Dr. Carter is a senior lecturer in agronomy at the University of Adelaide, Glen Osmond, Australia. He has twice served on the Purdue/AID Portugal Project, once in 1982 and again in 1983. He has been invited to return again this year for another six-week assignment.

The purpose of the 1984 assignment will be to serve as a short-term advisor in the area of forages and pastures. He will spend two weeks at the University Institute at Vila Real, two weeks at the University of Evora, one week working for the USDA/OICD PROCALFER project, and the final week will spent on wrap-up activities and report writing for the AID/Portugal project. His proposed schedule is:

April 23 - May 4	--	at the University of Evora (UE)
May 7 - May 18	--	at the University Institute of Vila Real (IUTAD)
May 21 - May 25	--	PROCALFER Project
May 28 - June 1	--	Wrap-up activities at UE and IUTAD; writing end-of-tour report for AID/Portugal Project

The specific duties of Dr. Carter's visit will be basically the same at Evora and Vila Real. He will review, analyze and discuss research work being conducted with the soil/plant/animal science staff on forage and pasture production management; provide advice and assistance on implementation of future research projects; present several seminars at each university; and visit the regions to observe and offer advice on established research work and projects implemented by the universities and the Regional Agricultural Services.

IPIA Agricultural Administration Building
West Lafayette, Indiana 47907
(317) 494-6876 Telex: 276147 AGAD-PU LAF

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APPENDIX B

Program of Work
and
Daily Itinerary

UNIVERSIDADE DE EVORA

PROGRAM FOR DR. EDWARD CARTER
April 24 - June 1, 1984

April 24 - Arrival on TAP 451 at 16.25
André Dordio and David Crespo will meet Dr. Carter at Lisbon airport.
Trip to Évora.
Stay at University Inn.

April 25 - Holiday
Will be picked up by Pedro Silveira for lunch

April 26 - Contact with the Crop Science Department
10.00 - Prof. José Albuquerque
10.30 - Pedro Vacas de Carvalho and Pedro Silveira
11.30 - Maria do Rosário Oliveira
14.30 - Visit Experimental Farm of Mitra with José Avó
17.00 - Discuss the future of EIPO Grazing Experiment with Pedro Silveira, Manuel Cancela de Abreu and José Avó.

April 27 - 8.30 - Visit Experimental Farm of Daroeira with the Administrative Committee (Pedro Silveira, José Banza and Joaquim Garcia)
Discussions with the Technical Committee about future experiments in the farm :
José Albuquerque, José Banza, Orlando Reis, José Avó, Pedro Silveira, Pedro Vacas de Carvalho and Helena Estudante.
15.00 - Visit Experimental Farm of Outeiro with the Administrative Committee (Orlando Reis, Carlos Remendinho).

April 30 - 9.00 - Visit farms in the region of Montemor-o-Novo with Pedro Vacas de Carvalho.
14.30 - Visit farms in the region of Estremoz, Bencatel and Redondo with Pedro Vacas de Carvalho and Pedro Silveira.

May 1 - Prepare seminar

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May 2	- 10.00	- All day seminar for students and Academic staff. - "Land use in Australia: Tillage and seedbed preparation" - "Pasture production and management" - "Techniques for measuring pasture yield and botanical composition".
	17.00	- Discuss tillage experiments with G. Basche.
May 3	- 8.30	- Visit farms in the region of Beja, Serpa and Mertola with PROCALFER team.
May 4	- 9.30	- Visit farms in the region of Évora and Alcãçovas with the PROCALFER team.
	15.00	- Discussion on PROCALFER experiments in Direcção Regional de Agricultura do Alentejo.
May 5	-	Leave Évora to Guarda with Pedro Silveira. Visit farm in Caria region with Mário de Carvalho, G. Basche and Prof. Delgado Domingos.
May 6	-	In transit to Vila Real by Pinhel, Mogadouro, Miranda do Douro, Bragança and Mirandela.
May 7 to May 19		- At IUTAD - Vila Real
May 21	- 9.00	- Visit fertilization trials in Herdade de Pinheiros with Francisco Garcia and José Gonçalves Ferreira.
	11.00	- Visit sheep farm in Escoural region.
	15.00	- Visit Experimental farm of Almocreva with the Administrative Committee (José Banza, C. Silva Carvalho and António Melro)
May 22 to May 24		- PROCALFER seminar in Elvas.
May 25	- 9.30	- Final meeting with the Crop Science Department
	15.00	- Meeting with Natural Sciences Department
	17.00	- Final meeting with the Rector.
May 28 to May 31		- Preparing Final Report
June 1		- Return to Australia

Curso sobre Pastagens e Forragens

MAIO			
21	10h	Apresentação e objectivos Esquema do Curso	J.Almeida Alves A.Dordio
	15h	Influência dos factores climático na produção da erva. Zonagem do país em relação às potencialidades.	T.Salgueiro
22	9.30h	Considerações sobre sistema solo/planta/animal	E.Carter
23	9.30h	Análise crítica da produção pratense e forrageira em Portugal.	E.Carter
	15.00h	Orientações a seguir.	
24	9.30h	Metodologia experimental a seguir em relação aos problemas de investigação sobre pastagens e forragens.	E.Carter
25	9.30h	Tipos de produção pratense e forrageira. Prados naturais e prados semeados. Culturas anuais, temporárias e permanentes de sequeiro e de regadio.	D.Crespo
	15.00h	Caracteristicas das espécies e cultivares a utilizar nos vários tipos de produção de erva.	Tavares de Sousa A. Romano
28	9.30h	Tecnologia da produção pratense e forrageira Correcção do solo.	

	11.15	Factores da nutrição mineral das plantas. Alguns dados sobre fertilização das forragens.	M. Vasco da Gama
	15.00	Carências e toxicidades com micronutrientes nas pastagens e forragens. Sua correcção.	E. Sequeira
	16.45	Inoculações das leguminosas pratenses e forrageiras com ryzobium. Alguns factores condicionantes.	J. Figueiredo Marques
29	9.30	Estabelecimento de culturas forrageiras e pratenses.	D. Crespo
	15.00	Maneio de pastagens e forragens de Sequeiro e regadio	D. Crespo A. Dordio
30		Visitas ao campo	
31	9.30	Necessidades de sementes. Experimentação sobre produção de semente.	A. Romano
	11.15	Qualidade das sementes Certificação de semente.	Rasquilho
	15.00	Tecnologia da produção de semente (1a. parte)	Consultor americano
JUNHO			
1	9.30	Tecnologia da produção de semente (2a. parte)	Consultor americano
	15.00	Discussão de algumas matérias apresentadas	
	17.30	Encerramento	

ITINERARY: AUSTRALIA - PORTUGAL - AUSTRALIA, APRIL 23 - JUNE 4,1984

(Including Main Organizations and Persons Contacted)

April 23 Departed from home at 2.30 pm for Adelaide Airport. Departed 5.00 pm on British Airways Flight BA 012 for London via Singapore and Muscat.

April 24 Arrived London 8.00 am and departed on TAP Flight TP 451 at 2.00 pm for Lisbon. Arrived 4.30 pm and met by Eng. David Crespo and Eng. Andre Dordio who conferred on my program in Portugal. With USAID driver to University of Evora, Conventina, accomodation at Mitra School of Agriculture arriving 8.00 pm after 38 hour trip from home. Met by Eng. Pedro Silveira and his wife Carmo who further discussed my program in Portugal.

April 25 National Holiday in Portugal. Sorting papers related to Portugal visit. To lunch with Pedro and Carmo Silveira and family. Met Prof. Jose Albuquerque.

April 26 Further discussions on assignment program in Portugal with Prof. Jose Albuquerque, Pedro Silveira, Pedro Vacas Carvalho and others. Discussed with Eng. Rosario Oliviera her legume research program on D.M. yield and distribution of roots, nodules, etc. with depth in the soil. Inspected Rosario's experiment in the field also recent field sowings of subterranean clover at Mitra also the EIPO experiment with Prof. Jose Albuquerque, Pedro Silveiro, Rosario Oliviera, Manuel Cancela d'Abreu and others. Continued discussions on the EIPO experiment at the office until 6.00 pm.

April 27 With Prof. Jose Albuquerque, Pedro Silveira, Pedro Vacas Carvalho, Jose Banza, Helena Estudante, Jose Avo and Orlando Reis to visit the University of Evora farms Daroeira and Outeiro.

April 28 Sorting information and slides for seminars. Saw Rector Azevedo with Pedro Silveira.

April 29 Re-looked at long-term rotation experiment and EIPO stocking rate experiment at Mitra. Preparing for seminars.

April 30 Departed from Mitra 9.00 am with Pedro Vacas Carvalho visiting four farms (Santiago do Escoural, Torre da Gadanha, Montemor-o-Novo, Estremoz) involved with World Bank (PCAA) loans. Joined by Pedro Silveira after lunch and saw two more farms (Bencatel, S. Miguel de Machede) receiving PCAA credit for pasture improvement arriving back at Conventina, Mitra, at 9.00 pm.

May 1	Pegged sampling sites on EIPO grazing experiment ready for seminar and field studies. Decided final recommendation on future of EIPO experiment. Preparing for seminars.
May 2	Presented all day course for staff and students 9.30 - 5.30 pm at Herdade da Mitra covering soil-plant-animal aspects of pasture production and utilization.
May 3	Departed 9.00 am from Mitra with Pedro Silveira and Andre Dordio and members of D R Evora to visit Beja (Herdade Morenos - farmer Bento Canoilas), Vale Formosa and other field sites using PROCALFER money to fund research. Arrived back 9.00 pm.(Joaquim Peres Costa, Jose Franco de Sousa - PROCALFER Evora; Jose Pameiro, Rui Garrido - D R Beja and Jose Romana - Brigado Mertola).
May 4	To University of Evora to arrange administrative details. With Pedro Silveira, Andre Dordio and other Ministry of Agriculture staff cooperating on the PROCALFER program to see pastures on Herdade do Atafonas and to farm of Francisco Nuncio near Alcocovas with excellent pastures based on subterranean clover.
May5	Departed Conventina, Mitra, at 8.00 am with Pedro Silveira en route to Herdade do Tapadad (Costa Pinta) to examine soil and pasture then on to farm of Prof. Dalgardo Domingos near Caria to inspect spontaneous legume pastures with Eng. Mario d'Carvalho and Gottlieb Basch (GTZ). Advised Prof. Domingos on various procedures for clearing bush and establishing pastures. On to Guarda for night.
May 6	Travelled with Pedro Silveira north via Pinhel, Freixo de Espada a Cinta, Mogadouro, Miranda do Douro and Vimosa to Braganca then south west via Mosca, Romeu Mirandela and Murca to Vila Real, examining soils and pastures en route. Arrived at 9.00 pm. Met with Nuno and Ana Moreira over dinner.
May 7	Inspected some of activities of IUTAD at Quinta de Prados with Nuno Moreira then to see Animal Pathology Laboratory (Dr Jorge Rodrigues) and Soils Laboratory (Eng. Jaoa Coutinho) then to visit Rector Professor Real. Preparing for seminar. Presented 3-hour seminar on soil/plant/animal research and production. Dinner with Nuno and Ana Moreira, Prof. Joaquim Pereira and Dr Ryan (Agricultural Research Institute of Ireland).
May 8	Inspecting and discussing oat/vetch experiments of Nuno Moreira and others in the Department of Plant Production. Inspected grazing experiment and new administration and laboratory buildings at Quinta de Prados.

May 9	Met with staff of Animal Production and Animal Nutrition Department and inspected laboratory and animal house facilities. Jorge Azevedo (sheep and goats), Dr Jose Potes (cattle), Dra Aura Colaco (physiology laboratory), Carlos Sequeira (nutrition laboratory). Attended seminar/discussion meeting of the soil/plant/animal staff at IUTAD.
May 10	Departed 8.00 am with Nuno Moreira for Mirandela to meet with DRTM staff at the research farm Valonga. Those present: Eng. Augusto Lage, Regional Head of Crop Division and PROCALFER activities; Jose Raposo, Sacramento Lopes (sheep production); Conceicao Lopes (seed production) and Jaime Maldonado (pastures) all of whom are involved with the PROCALFER acivities. Also Eng. Fernando Gusmao (Head of the Agricultural Production Service of the Regional Directorate of Agriculture of Tras-os-Montes e Alto Douro and Coordinator of the World Bank Project in the Region) called briefly for discussions. Inspected 6 experiment sites involving cereals, pastures and forage crops between Mirandela and Mirando do Douro. Inspected sheep flock and Mirandez cattle at Posto Experimental Malhadas. Overnight at Mirando do Douro.
May 11	Departed 8.30 am with Nuno Moreira from Mirando do Douro to the farm of Jose Casihiro Pereira, San Loane, Mogadouro and inspected various sown forage crops and spontaneous pastures with farmer and Jose Raposo and Jaime Maldonado. Lunch at Mogodoura then on to Quinta d'Alva at Barca D'Alva (Eng. Mariano Pego, Manager) to see new sowings of pasture on steep olive grove and orchard land. Returned to Vila Real via Figueira de Castelo Rodrigo, V.N. de Foz Coa, S. Joao da Pesqueira and Regua.
May 12	Drafting report on assignment in Portugal.
May 13	Preparing for seminars on research techniques used in measuring pasture and forage crop production and utilization in southern Australia.
May 14	Inspecting and discussing pasture and forage crop laboratory and harvesting facilities with Nuno Moreira. Led four hour seminar/tutorial on methods used to evaluate pasture and forage crop production and utilization.
May 15	Discussed ongoing and planned research projects with Eng. Arnaldo Silva, Eng. Armando Mascarenhas, Eng. Carlos Sequeira and Lic. Jorge Azevedo. Inspected class rooms for lectures and practical work. Re-looked at some parts of ruminant research in animal barns.

May 16	Departed 8.00 am with Nuno Moreira and Fernando Mota (Department of Forestry) to see dairy pastures in the Vila Pouca de Aguiar valley and other areas. Inspected seven high altitude pastures sown by the Department of Forestry in the Vila Pouca de Aguiar - Boticas, Lavra and Salto areas for common grazing by villagers as part of over-all forest protection program. Returned to Vila Real 8.00 pm.
May 17	Departed 8.00 am with Nuno Moreira for the Minho region of North West Portugal. Visited two dairy farms in the Vila Nova de Famalicao area. On to Atlantic coast at Povoa de Vazim to see coastal land use - intensive vegetable growing at ground level and below ground level in excavated sandy soil areas (to utilise shallow water tables). Returned to Vila Real 8.30 pm.
May 18	Reported to Rector Professor Fernando Real, Vice Rector Professor Joaquim Pereira and USAID Coordinator at IUTAD, Professor Jose Pereira on the consultancy. Final discussions with Nuno Moreira, Joao Coutinho (Geosciences), Jorge Azevedo, Carlos Sequeira and Armando Mascarenhas. Discussed techniques of measuring pasture plant communities with Francisco Rego (Department of Forestry).
May 19	Returned to Evora via Coimbra arriving at Conventina at 10.45 pm.
May 20	Working on rotation experiment problems of Gottlieb Basch (GTZ) and others and soil fertility study proposals of Francisco Garcia and Jose Ferreira.
May 21	With Pedro Silveira to main University centre to see Garcia and Ferreira re soil fertility experiment. Collected Professor Outhouse and Eng. Avo and visited several good natural pastures. Lunch at Alcocovas than on to Beja to inspect the University farm Almocreva. Met Eng. Banza and Helena Estudante at Almocreva.
May 22	Presented four seminars with discussion periods at IVIA Plant Improvement Station at Elvas for PROCALFER trainees.
May 23	Presented four seminars with discussion periods at IVIA Plant Improvement Station at Elvas for PROCALFER trainees.
May 24	Presented four seminars with discussion periods at IVIA Plant Improvement Station at Elvas for PROCALFER trainees. Demonstrated use of Levy Point Quadrat and methods of estimating botanical composition.

May 25	Met Mario Carvalho and Gottlieb Basch re rotation experiments. Discussed proposed siting of pasture-forage crop laboratories with Pedro Silveira and Afonso de Almeida (Animal Sciences). To Geosciences Department for discussions with Francisco Garcia and Professor Mariano Feio.
May 26	Re-looked at EIPO stocking rate experiment. Designing laboratories for pasture-forage crop, livestock and soils research workers.
May 27	Sorting papers and writing for report.
May 28	Visited Herdade de Zambujeira property of Jorj and Carolyna Van Voorst to see pastures and haymaking operation.
May 29	Showed slides and discussed tillage and sowing equipment with Eng. Banza and Helena Estudente. Preparing to calibrate John Shearer Drill. All afternoon with final year Agronomy students discussing methods of assessing yield and botanical composition.
May 30	Departed from Mitra for Lisbon at 9.00 am with Pedro Silveira. To Oeiras to meet with James Black USDA/OICD administrator and Almeida Alves regarding the PROCALFER program. On to United States Embassy for debriefing sessions with Jose Luis Pinheiro, James Black and Dr Michael Lukomski, Director of the office of Economic Cooperation.
May 31	Departed Flight TP552 from Lisbon to Frankfurt and onto Bad Soden for night. Contacted GTZ officer Dr Wolpers regarding program to visit GTZ and University of Goettingen on Friday June 1.
June 1	With Dr Wolpers to the Eschborn headquarters of GTZ for discussions relevant to Portugal then by train to Goettingen for discussions with Prof. Dr. Achnicht. Returned to Bad Soden.
June 2	Visited International Agricultural Exhibition at Frankfurt with special attention to tillage and sowing machinery of potential use in Portugal. Departed Frankfurt on Flight LH694 for Singapore.Changed planes.
June 3	Departed from Singapore on BA011 for Adelaide.
June 4	Arrived Adelaide Airport 8.00 am thence to home.