

# Intake and digestibility of four subtropical pasture mixtures<sup>\*1/</sup> \_\_\_\_\_ W. M. MURPHY\*\*, J. M. SCHOLL\*\*, R. E. ROFFLER\*\*

## RESUMO

O valor nutritivo baixo das pastagens nativas limita a produção de gado no estado do Rio Grande do Sul, Brasil. Resultados de pesquisas realizadas em outras áreas tropicais tem mostrado que a produção de gado aumenta e apresenta menor variação quando os animais são mantidos em pastagens nativas melhoradas pela introdução de novas espécies. O valor nutritivo das pastagens depende da ingestão voluntária e da digestibilidade. Foram conduzidos experimentos com ovelhas para avaliação da ingestão e digestibilidade de quatro combinações de gramíneas e leguminosas perenes, compostas de espécies com potencial para uso no melhoramento das pastagens naturais do Rio Grande do Sul.

Capim de Rhodes (*Chloris gayana* Kunth) ou Pangola (*Digitaria decumbens* Stent.) foram cultivadas com desmodium (*Desmodium intortum* [mill.] Urb) ou Siratro (*Macroptilium atropurpureum* [D.C.] Urb) num Oxisol nas proximidades de Porto Alegre, Rio Grande do Sul. O feno obtido de um estudo de manejo e corte de pastagem, com duração de quatro meses, no ano de semeadura das misturas, foi usado nos experimentos de ingestão e digestibilidade. Em consequência, a quantidade de inços era maior e a de leguminosas menor do que seria nos anos seguintes. Como esta é uma condição sempre existente durante o estabelecimento, os resultados são uma boa indicação do que pode ser esperado destas misturas no ano da semeadura.

Com exceção do nitrogênio, os coeficientes de digestibilidade foram mais altos para a mistura capim de rhodes-desmodium do que para as outras misturas. A digestibilidade da matéria seca (DMS) variou de 56,2 a 60% da ingestão. A digestibilidade da matéria orgânica (DMO) sofreu variação de 57,2 a 61,6%. A digestibilidade do nitrogênio variou de 59,3 a 67,1%, tendo atingido os valores mais altos na mistura de Pangola com Siratro. A Energia Digestível (ED) variou de 53,6 a 57,1%.

Ad libitum ingestão de matéria seca variou de 33,1 a 51,8 g/w kg<sup>0,75</sup> e não estava relacionada com DMS. As ovelhas que receberam a mistura capim de rhodes-desmodium obtiveram quantidades suficientes de proteína digestível (PD) (4,0 g/w kg<sup>0,75</sup>) e ED (125,2 Kal/kg<sup>0,75</sup>) para suprir as necessidades de manutenção. As ovelhas que receberam as outras misturas obtiveram suficiente PD (média = 3,9 g/w kg<sup>0,75</sup>) para finalidades reprodutivas, mas PD (média = 95,2 kcal/kg<sup>0,75</sup>) foi insuficiente para a manutenção. Todas as misturas apresentaram quantidades excessivas de PD em relação a ED.

Os resultados obtidos mostram que, durante o ano de estabelecimento, a mistura capim de rhodes-desmodium satisfaria as necessidades nutritivas de ovelhas, enquanto que as outras misturas testadas não preencheriam todos os requerimentos.

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### Introduction

IN RIO Grande do Sul, Brazil, the livestock industry is based almost entirely on native pastures.

Their low feeding value limits production (3,4). Studies in other areas of the tropics (2, 10, 11, 12) have shown that livestock production increases and varies less when animals graze sown pastures of introduced plant species. The nutritive value of pasture plants depends on voluntary intake and digestibility. Therefore, information on these aspects of plants potentially useful for improving pastures in Rio Grande do Sul is important.

This study was conducted to evaluate voluntary intake and digestibility of four perennial, subtropical, grass-legume pasture mixtures in Rio Grande do Sul.

### Materials and methods

This study was conducted at the Federal University of Rio Grande do Sul at Porto Alegre. The mixtures were established at a site with an altitude of 35 m, 50 km west of Porto Alegre. The soil was São Jerônimo sandy clay (Oxisol), which is well-drained and gently undulating (5). The site had been used only as native pasture and had never been plowed.

Annual precipitation near Porto Alegre averages 1,322 mm, with moisture deficiencies usually occurring during the summer. Mean annual temperature is 19.3 C. Mean maximum temperature for the hottest month (January) is 30.4 C; mean minimum for the coldest month (July) is 9.2 C. Several frosts usually occur each month from May to September (5).

Rhodesgrass (*Chloris gayana* Kunth) and "Pangola" digitgrass (*Digitaria decumbens* Stent), were grown in mixtures with desmodium (*Desmodium intortum* [Mill.] Urb) and "Siratro" (*Macroptilium atropurpureum* [D. C.] Urb). Field plots were arranged as a randomized complete block, in a split-split plot design, replicated four times. Each mixture was sown in 7 by 8 m plots, that were split into 2 by 7 m subplots for cutting treatments. A soil test showed that phosphorus (P) level was very low at 1.5 to 2.0 ppm and potassium (K) level was high at 135 to 175 ppm. Soil pH level was 5.1. According to soil test recommendations, 3,400 kg/ha of CaCO<sub>3</sub> was applied and disced into the soil 3 months before seeding; 68.8 kg/ha of P were disced into the soil 1 week before seeding.

Grasses were sown in October 1970 in rows 33 cm apart. Rhodesgrass was sown at 4 kg/ha, and stolons (22 cm long) of "Pangola" were planted at 10-cm depths, 25 cm apart. Scarified and inoculated legume seed was broadcast between the rows at rates of 5 and 7 kg/ha for desmodium and "Siratro", respectively, and the soil was compacted with a cultipacker.

The mixtures were cut at 3- or 6-week intervals at stubble heights of 5 or 13 cm. A 0.9 by 6 m sample area was harvested from the middle of each subplot for yield. The entire amount harvested, except for a 0.5 kg subsample for chemical analyses and hand separated for botanical composition determinations, was

dried in a forced-draft dryer at 60-65 C and stored for intake and digestibility trials with sheep.

Cutting treatments began when rhodesgrass reached the early heading stage of growth, 9 weeks from seeding date. Plots were harvested either six times every 3 weeks or four times every 6 weeks, between 30 December 1970 and 8 May 1971, when the first frost of autumn occurred. Samples from all treatments and harvests for each mixture were combined to obtain enough material for the intake and digestibility trials. The combined material was chopped with a flail chopper and mixed thoroughly to minimize selective feeding.

Three yearling Ideal (a Merino cross also known as Polworth) wether sheep were used to evaluate each mixture. Four 23-day trials were used. Each trial consisted of a 7-day preliminary period, a 7-day intake measurement period, and a 9-day digestibility-measurement period.

During the preliminary and intake-measurement periods, animals were kept in individual pens and fed *ad libitum*. Enough feed was offered them in two equal daily feedings so that 100 to 150 g remained in excess each day. The amount remaining was removed, weighed, and discarded daily. At the end of the intake-measurement period, mean daily voluntary consumption was determined for each animal.

During the digestibility-measurement period, animals were kept in metabolism cages. They were given two daily feedings that together equaled 90 per cent of their mean daily voluntary consumption. Feeding was restricted to force them to have a more constant consumption and to reduce selective feeding and the amount of feed remaining in excess daily. Since non-digested residues of a given meal require about 48 hours to pass through the ruminant digestive tract, feces were collected only during the last 7 days of the 9-day period. Urine also was collected only during the last 7 days. Feces were weighed daily and 20 per cent of the amount obtained each day was stored under refrigeration as one cumulative sample for analyses. The daily volume of urine produced was measured and 50 per cent of this was acidified with 2 ml of concentrated H<sub>2</sub>SO<sub>4</sub> per liter and stored under refrigeration as one cumulative sample for analysis. On the 7th day of the period, accumulated feed that had been refused was collected, weighed, ground to pass a 40-mesh screen, and stored for analyses. Subsamples were taken from the daily feed; this material also was ground and stored for analyses.

Individual body weights were recorded at the beginning and end of the intake measurement period, and on the 7th day of the digestibility-measurement period, to determine rate of weight gain or loss. Average weight during the intake-measurement period was used to calculate metabolic body size ( $W^{0.75}$ ), which was used to express intake of digestible nutrients.

All chemical analyses were conducted with methods approved by the Association of Official Agricultural Chemists (1). Gross energy (GE) of mixtures and feces was determined with a bomb calorimeter. Crude protein (CP) was calculated using the factor 6.25 times Kjeldahl nitrogen (N) concentration.

## Results

Table 1 presents the botanical and chemical compositions of mixtures fed to sheep. The rhodesgrass-*Siratro* mixture had the lowest legume and highest grass contents. Weeds mainly *Setaria* spp. and crabgrass (*Digitaria sanguinalis* L.) content of rhodesgrass mixtures was nearly 50 per cent less than that of "Pangola" mixtures. Crude protein concentrations of the mixtures was in the order of: "Pangola" - "Siratro" > "Pangola" - desmodium > rhodesgrass - desmodium > rhodesgrass - "Siratro". Analysis of separate components of mixtures at each harvest indicated that CP concentration in "Pangola" (mean over all harvests = 15.0%) was consistently greater than that of rhodesgrass (mean over all harvests = 13.2%). The CP concentration in legumes was nearly the same (mean over all harvests = 25.2%). Organic matter and GE concentrations were uniform for all mixtures.

Table 2 presents the digestibility, voluntary intake, and N balance data from the trials. Digestibility values for the rhodesgrass-desmodium mixture were higher than those other mixtures, with the exception of N digestibility. Nitrogen digestibility equaled that of rhodesgrass - "Siratro" and "Pangola" - desmodium, but was lower than that of "Pangola" - "Siratro". Dry matter (DM) intakes ranged from 33.1 to 51.8 g/W kg<sup>0.75</sup>. Percentage DP was higher for "Pangola" - "Siratro" (11.0%) and "Pangola" - desmodium (9.6%) than it was for rhodesgrass-desmodium (7.9%) and rhodesgrass - "Siratro" (7.6%). Digestible protein intake was in the same order as above. The DE concentrations

Table 1.—Botanical and chemical composition of four pasture mixtures fed to sheep at Porto Alegre, Rio Grande do Sul, Brazil.

Component	Botanical composition*	Crude protein	Organic matter	Gross energy
	% by dry wt	% of DM	% of DM	kcal/g DM
Rhodesgrass	67			
"Siratro"	12			
Weed	21			
Mixture		12.8	90.4	4.32
Rhodesgrass	56			
Desmodium	22			
Weed	22			
Mixture		13.1	90.5	4.28
"Pangola"	33			
"Siratro"	24			
Weed	43			
Mixture		16.6	90.5	4.34
"Pangola"	26			
Desmodium	36			
Weed	38			
Mixture		15.7	91.2	4.40

\* Average over all cutting treatments and harvests

Table 2.—Digestibility, intake, and N balance of four pasture mixtures fed to sheep at Porto Alegre, Rio Grande do Sul, Brazil

Assay conducted	Mixtures			
	Rhodesgrass- <i>Siratro</i>	Rhodesgrass-Desmodium	"Pangola" "Siratro"	"Pangola" Desmodium
<i>Digestibility, % of intake.</i>				
Dry matter	57.3*	60.0	56.5	56.2
Organic matter	59.0	61.6	57.5	57.2
Nitrogen	59.3	60.2	67.1	60.9
Gross energy	55.3	57.1	53.6	53.8
<i>Intake:</i>				
Dry Matter, g/W kg <sup>0.75</sup>	33.1	51.8	42.5	45.8
Digestible crude protein, g/W kg <sup>0.75</sup>	2.5	4.0	4.8	4.4
Digestible energy, kcal/kg <sup>0.75</sup>	78.9	125.2	98.8	108.0
<i>Nitrogen, % of intake</i>				
Fecal	42.4	39.8	32.9	39.1
Urinary	41.3	43.8	40.1	41.9
Retention	16.4	16.4	27.0	19.0

\* Each value is the mean of values from three sheep.

were uniform, at about 2.35 kcal/g of DM. Intake of DE was in the order of: rhodesgrass-desmodium > "Pangola" - desmodium > "Pangola" - "Siratro" > rhodesgrass - "Siratro". Sheep were in positive N balance on all mixtures. They retained more N when fed "Pangola" mixtures than when fed rhodesgrass mixtures.

## Discussion

Where the only source of feed available for livestock is grazed or stored herbage, the pasture must fulfill livestock requirements for energy, protein, vitamins, and minerals. Under almost all grazing situations, energy usually becomes the first limiting factor, and animal needs for other nutrients can be considered in relation to energy intake. Weston and Hogan (13) have suggested that grazing ruminants, consuming enough energy for productive purposes, automatically receive adequate amounts of amino acids. Maintenance requirements of sheep, established by the National Research

Council (9), ate 119 kcal DE/W kg<sup>0.75</sup> and 238 g DP/W kg<sup>0.75</sup>. Combining these values gives a ratio of 20 g DP per Mcal DE.

In this study, sheep fed all four pasture mixtures ate sufficient DP for productive purposes. Only sheep fed the rhodesgrass-desmodium mixture, however, also ate sufficient DE to meet maintenance requirements. Examination of DP/DE ratios (range = 31.6-48.6 g DP/Mcal DE) indicated that all mixtures contained excessive DP in relation to DE.

Dry matter intake of many temperate grasses is related closely to energy and DM digestibilities, and digestibility *per se* has been regarded as an accurate measurement of feeding value. Intake of subtropical grasses, however, has been found to be poorly related to digestibility and, consequently, digestibility alone is not a good indicator of the feeding value of subtropical forages (8).

In this study, intake also was found to be poorly related to digestibility. As is evident in Table 2, "Siratro" mixtures, and particularly the one with rhodesgrass, had DM intakes lower than those of other mixtures, whereas energy and organic matter digestibilities were similar to those of other mixtures. According to Milford and Minson (8), intake of subtropical grasses decreases when DP concentration of forage is below 7 per cent, because of depression of bacterial activity in the rumen by lack of N. This would not appear to be the reason for the extremely low intake of rhodesgrass-"Siratro", which had a CP concentration of 12.8 per cent. The low intake may have been due to a problem of palatability, since the mixture was composed mainly of rhodesgrass (67%), with 21 per cent weeds and only 12 per cent legume. Dry matter intake of the mixture was similar to that obtained by Milford and Minson (8) for rhodesgrass cv. 'Samford' in Queensland, Australia. The low intake of "Pangola"- "Siratro" also cannot be accounted for by a low CP percentage, because it contained more CP than the other mixtures. This mixture had a more favorable balance of grass (33%) and legume (24%), but weed content was high (43%), indicating that a problem of palatability may have existed.

From digestibility trials with sheep in Queensland, Australia, Milford (6) reported that subtropical grasses cannot be evaluated using feeding standards for temperate forages. The crude fiber fraction was found to be highly digestible in comparison with other proximate constituents, and it was not related to nutritive value of the herbage during most of the year. He concluded that the most suitable criteria for expressing nutritional values of subtropical forages are digestible DM, DP, DE, DM intake, and N balance. Wide seasonal fluctuations in DM intake and digestibility occurred with almost all grasses tested. Decline in intake was more important than decline in digestibility. According to Milford, a high level of livestock production can be maintained only if DP intake is adequate to maintain a positive N balance. About 3.5 per cent DP was the minimum required for positive N balance in sheep. All mixtures in this study contained adequate levels

of DP (7.6-11.0%). The different positive N balances observed in this study reflected different DP concentrations of the material fed.

Of necessity, this study was limited to an evaluation of the mixtures in their seeding year. Consequently, weed contents were higher and legume contents were lower in the mixtures than they would have been later. Since this problem always exists during early establishment, the results indicated what could be expected with these mixtures in their seeding year.

#### Acknowledgement

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#### Summary

Low feeding value of native pastures limits livestock production in Rio Grande do Sul, Brazil. Research in other areas of the tropics has shown that livestock production increases and varies less when animals graze improved pastures of introduced plant species. The nutritive value of pasture plants depends on voluntary intake and digestibility. Trials were conducted with sheep to evaluate intake and digestibility of four perennial subtropical grass-legume mixtures, composed of plants potentially useful for improving pastures in Rio Grande do Sul.

Rhodesgrass (*Chloris gayana* Kunth) or "Pangola" digitgrass (*Digitaria decumbens* Stent.) were grown each with desmodium (*Desmodium intortum* [Will] Urb) or "Siratro" (*Macroptilium atropurpureum* (D.C.) Urb) on an Oxisol near Porto Alegre, Rio Grande do Sul. Herbage for the intake and digestibility trials was obtained during a 4-month period of a cutting-management study in the seeding year of the mixtures. Consequently, weed contents were higher and legume contents were lower in the mixture than they would have been later. Since this problem always exists during early establishment, the results indicated what could be expected with these mixtures in their seeding year.

Except for nitrogen, digestibility coefficients were higher for the rhodesgrass-desmodium mixture than for other mixtures. Digestible dry matter (DDM) ranged from 56.2 to 60.0 per cent of intake. Digestible organic matter ranged from 57.2 to 61.6 per cent. Digestible nitrogen ranged from 59.3 to 67.1 per cent, and was highest for the "Pangola"- "Siratro" mixture. Digestible energy (DE) ranged from 53.6 to 57.1 per cent.

*Ad libitum* dry matter intakes ranged from 33.1 to 51.8 g/W kg<sup>0.75</sup>, and were poorly related to DDM. Sheep fed the rhodesgrass-desmodium mixture ate sufficient amounts of both digestible protein (DP) (4.0 g/W kg<sup>0.75</sup>) and DE (125.2 kcal/kg<sup>0.75</sup>) to meet maintenance requirements. Sheep fed the other mixtures

ate sufficient DP (Average = 3.9 g/W kg<sup>0.75</sup>) for productive purposes, but insufficient DE (average = 95.2 kcal/kg<sup>0.75</sup>) for maintenance. All mixtures contained excessive DP in relation to DE.

The results indicated that, during early establishment, rhodesgrass-desmodium would satisfy nutritive requirements of sheep, whereas the other mixtures tested would not.

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## Notas y Comentarios

### La urea mejora el contenido de proteína del arroz

Aunque ha habido un inmenso esfuerzo en la investigación de fertilizantes para aumentar los rendimientos de los cereales, y en el mejoramiento genético para maximizar los contenidos de proteína, un reciente artículo de Iwate, Japón sugiere que procedimientos simples podrían todavía rendir grandes beneficios. Kazuo Honjyo y sus colaboradores del Departamento de Agricultura de la Universidad de Iwate han demostrado que se puede aumentar el contenido de proteína del arroz en más de 40 por ciento, no tanto con la aplicación del fertilizante al suelo como asperjando las hojas con una solución de urea (*Agricultural and Biological Chemistry*, vol. 41, p. 477).

Honjyo y su grupo habían observado previamente este aumento en el contenido de proteínas y en su artículo reciente exploran las consecuencias agrícolas y nutritivas. Primero, el procedimiento es notablemente simple. En su reciente experimento, el grupo de Iwate sembró el arroz a fines de mayo como de costumbre. A mediados de agosto, cuando el arroz estaba en el estado de pleno espigado, asperjaron el campo experimental tres veces con una solución de 2 por ciento de urea que contenía una pequeña cantidad de detergente. El arroz fue cosechado a comienzos de octubre. El tratamiento de aspersión no tuvo efecto sobre el rendimiento del arroz, pero, como pasó en los ensayos anteriores, aumentó grandemente el contenido proteico del arroz (hasta 11 por ciento

de proteína). Algo de este aumento se operó en el afrecho, pero el grueso estuvo en el arroz pulido (endosperma).

En segundo lugar, estructuralmente la proteína del arroz asperjado con urea no fue diferente de la de los testigos. La mayor parte del aumento ocurrió en las proteínas solubles en álcalis conocidas como glutelinas, pero no hubo cambios en la composición de los aminoácidos o en la movilidad electroforética de estas proteínas. Además, cuando se evaluó el valor nutritivo de la proteína del arroz mediante tres pruebas convencionales, se encontró que, gramo por gramo, la proteína del arroz asperjado era igual a la de los testigos, pero que había mayor cantidad de ella.

### Asistencia técnica de Brasil para Paraguay

El Brasil va a prestar asistencia técnica y efectuar el reentrenamiento de técnicos paraguayos en geología y mineralogía, uso y manejo del suelo, tecnología de madera, tecnología de alimentos, y administración de instituciones técnicas. El desarrollo de estas actividades fue acordado en una reunión entre la Dirección del Consejo Nacional de Desarrollo Científico y Tecnológico del Brasil (CNPq) y el Director del Instituto Nacional de Tecnología y Normalización del Paraguay, con la participación de representantes del Ministerio de Relaciones Exteriores. El convenio firmado, según *Planeamiento e Desenvolvimento* (Vol. 5, N° 49), encaja dentro del espíritu del Acuerdo Básico de Cooperación Cultural, Científica y Tecnológica existente entre los dos países.

*Décimo Congreso Mundial de Buiatría*

El Décimo Congreso Mundial de Buiatría, organizado por la Asociación Mexicana de Médicos Veterinarios Especialistas en Bovinos, se realizará en Ciudad de México, del 16 al 19 de agosto de 1978. Los temas por tratar son reproducción, problemas de producción de carne y de leche en el trópico, nutrición, y temas libres. Habrá traducción simultánea al español, inglés, alemán y francés. El secretario General del certámen es el Dr. Fernando Hidalgo y Terán, Avenida Morelos 20-707, México 1, D. F.

*Veneno para las superratas*

Se ha lanzado al comercio un superveneno para matar a las ratas y ratones que han desarrollado resistencia a la warfarina o se han dado cuenta de que la warfarina es deletérea a su salud y rehusan por eso comerla. Estos superroedores aparecieron primero en Dinamarca y después en Gran Bretaña. Ahora se han hecho presentes al otro lado del Atlántico, donde los norteamericanos los están cazando con un veneno francés llamado clorofacinona.

La patente para el nuevo veneno está en poder de la firma Chempar Chemical. Esta pequeña compañía recibió del laboratorio de control de roedores, de Nueva York, ocho ratones y cinco ratas, todos ellos con certificados de ser resistentes a la warfarina. Todas las ratas murieron antes de los seis días de ser puestas en dietas condimentadas con el nuevo veneno; los ratones, a los doce días.

Chempar ha comenzado a vender el veneno con el nombre de Rozol y ha otorgado permiso a una firma en Tennessee, para fabricarlo y venderlo con el nombre más imaginativo de Hot Shot. Los cazadores de ratas han experimentado alivio. La resistencia que los roedores comenzaron a desarrollar a la warfarina a comienzos de los noventa se volvió sorpresa desagradable; cuando fue desarrollada por la Wisconsin Alumni Research Foundation, a comienzos de los noventa cuarenta, fue considerada como el raticida final.

Las ratas y ratones en el pasado siglo han sido matados con arsénico, cianuro de calcio, fósforo amarillo, estricnina, sulfato de talio y carbonato de bario. Todos tenían la desventaja de que cuando los roedores comían estos venenos y se enfermaban, o cuando veían a sus compañeros comerlos y morirse, aprendían a no tocarlos nunca más. O, como dicen los cazadores de ratas: "Todos causan timidez a los cebos cuando se consume una dosis sub-lethal".

Los científicos concluyeron que lo que necesitaban era un agente que trabajase tan lentamente que ninguna rata, por más inteligente que fuera, podría posiblemente conectarlo con algún alimento específico que hubiera ingerido o con la muerte de otras ratas. Se creyó que la warfarina era la respuesta: un agente anticoagulante que podía matar mediante hemorragias internas solamente después de cinco o más comidas.

Un cuarto de siglo más tarde, las superratas, y aun algunos ratones también, han aprendido finalmente a evitar la warfarina. La clorofacinona, que es también anticoagulante, las tiene desconcertadas por ahora. Las ratas probablemente resolverán también este venenoso problema. Mientras tanto, las firmas productoras de la clorofacinona tendrán buenas ganancias, y esperamos que los científicos seguirán buscando nuevas trampas para ratas.

*Publicaciones*

*Agrociencia* La Facultad de Ciencias Agronómicas de El Salvador ha iniciado la publicación de *Agrociencia*, órgano científico que publica artículos originales de investigación. El primer número, de fecha enero 1977 tiene artículos sobre evaluación económica de pequeñas fincas, paquetes de información tecnológica, el clima de la tierra, y el índice de citas en ciencias. El editor es Manuel Nilhson Reyes.

*Investigaciones* La Universidad Nacional de San Cristóbal-Huamanga, en Ayacucho, Perú, ha iniciado en 1976 la publicación de una revista, *Investigaciones*, órgano institucional que divulgará los trabajos científicos de sus miembros. El primer número tiene la indicación "Vol. 1, Ciencias Naturales", lo que hace suponer que puede haber otros volúmenes. Tiene artículos sobre suelos, pastos, papa y mashua (*Tropaeolum tuberosum*).

*Irricab* Una revista de bibliografías anotadas sobre irrigación titulada *Irricab, current annotated bibliography of irrigation*, destinada a dar a conocer la literatura que trata no de irrigación en su sentido más amplio, sino de lo que en español se denomina *riegos*, es decir, excluyendo ingeniería hidráulica, hidrografía, recursos acuíferos, drenaje. Tiene por lo tanto un enfoque agronómico, que abarca desde la calidad del agua, sistemas de riego, cultivos bajo riego, suelos bajo riego, datos sobre economía y planificación. De periodicidad trimestral está publicada por el International Irrigation Information Center, un organismo conjunto de Israel y Canadá. La dirección en Israel, donde se imprime la publicación y donde trabajan los editores, es: Volcani Center, P.O. B. 49, Bet Dagan, Israel.

*Áreas Silvestres en Mesoamérica* La Unidad de Áreas Silvestres y Cuencas del Departamento de Ciencias Forestales del CATIE ha iniciado en Agosto de 1977 la publicación de un boletín informativo, *Áreas Silvestres en Mesoamérica*, destinado a brindar a los profesionales y público interesado en noticias sobre las actividades y eventos en el manejo de áreas silvestres en la región mesoamericana. Comprende secciones sobre acciones conservacionistas, planificación, manejo, expediciones, acción internacional, publicaciones. Los editores son Arne Dalfet y Róger Morales, el asesor el Dr. Budowski. El primer número contiene numerosas noticias y una descripción de la Mosquitia Hondureña, a la que se llama "La Amazonía Centroamericana".

*Boletín Informativo del CIARA*. La Fundación para la Capacitación e Investigación Aplicada a la Reforma Agraria (CIARA) de Venezuela, ha comenzado a publicar en agosto de 1977, un *Boletín Informativo*, destinado a divulgar las actividades de CIARA. El primer número tiene 56 páginas y contiene artículos sobre la fundación social de la Ley de Reforma Agraria Venezolana, y el Proceso Inflacionario y la Reforma Agraria, además de descripción de las actividades, entrevistas, movimiento de biblioteca, y publicaciones del CIARA. La dirección es Apartado 5080, Caracas.