AGR 6233 - Tropical Grassland Agroecosystems – Fall 2021

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Office Hours: Monday and Wednesday: 1:00 p.m. - 2:30 p.m. (or as needed)

Class Meeting Times:
Period 8-9 (3:00-4:30) Monday and Wednesday (426 McCarty Hall C)

Course Description:

Importance, ecology, ecosystems services, physiology, management, and utilization of sown grasslands in the tropics and subtropics. Emphasizes interactions between grassland plants and the environment, other plants, and grazing herbivores. Integrates a major effort to describe and compare several prominent production systems or alternative systems.

Course Objectives:

1. To learn the important anatomical, physiological, and morphological characteristics of forage plants and relate these characteristics to forage responses to management and to their performance in production systems.

2. To understand and integrate the important ecological concepts that determine relationships among forage plants, between forage plants and the environment, and between forage plants and the animals that consume them.

3. To recognize the potential and limitations of livestock production on planted and native tropical grasslands.

4. To be aware of the role of forages in integrated food crop-livestock and silvopastoral systems in warm climates and to understand how the needs of various systems impact choice of forage species.

5. To recognize the environmental impact of tropical forage-livestock systems and to be aware of the potential of good management to minimize negative environmental effects.

6. To delineate the ecosystem services provided by grasslands and their impact on the global environment.

7. To organize a volume of references that describes pertinent tropical plant-animal research.

8. To gain proficiency in synthesis of content from the scientific literature in oral and written forms.

Instructor's Approach:

We cover a wide range and significant quantity of material. Most sources of information and assigned readings are review articles or original research papers. I assume significant interest in the subject matter area and willingness to put forth appropriate effort to learn the material. If you have not had an introductory forage course and some training in animal nutrition, you may need to do some extra reading to aid your progress in the course. The material provided on Canvas will aid you in organizing course material.

The course is not an applied management course. Because of the diversity of your interests and eventual work assignments, we will try to develop the important biological concepts, i.e., relationships that are true in, or can be adapted to, a wide range of situations and environments. Applied information will arise in classroom discussions and course handouts. Examples used from the literature will also highlight individual species, but these examples will not provide comprehensive coverage of each important tropical legume or grass.

Text:

There is no text. Assigned readings and complete lecture outlines will be provided on Canvas by the instructor.

Other References of Interest (does not include journals; more recent listed first):

Collins, M., C.J. Nelson, K.J. Moore, and R. F Barnes (eds.). 2018. Forages, Volume I - An introduction to grassland agriculture 7th ed. Wiley & Sons Ltd., West Sussex, UK.

Gordon, I.J., and H.H.T. Prins (eds.). 2019. The ecology of browsing and grazing II. Springer Publishers, Cham, Switzerland.

Moore, K.J., M. Collins, C.J. Nelson, and D.D. Redfearn (eds.). 2020. Forages, Volume II - The science of grassland agriculture. 7th ed. Wiley & Sons Ltd., West Sussex, UK.

Rouquette, F.M., and G.E. Aiken (eds.). 2020. Management strategies for sustainable cattle production on southern pastures. Elsevier Publishers, Amsterdam, Netherlands.

Bogdan, A.V. 1977. Tropical pasture and fodder plants. Longman, New York.

Chapman, G.P. 1996. The biology of grasses. CAB International, New York.

Chapman, G.P., and W.E. Peat. 1992. An introduction to the grasses. CAB International, New York.

Fahey, G.C., M. Collins, D.R. Mertens, and L.E. Moser. 1994. Forage quality, evaluation, and utilization. American Society of Agronomy, Madison, WI.

Humphreys, L.R. 1991. Tropical pasture utilisation. Cambridge Univ. Press, New York.

Jung, H.G., D.R. Buxton, R.D. Hatfield, and J. Ralph. 1993. Forage cell wall structure and digestibility. American Society of Agronomy, Madison, WI.

Lemaire, G. et al. (ed.). 2000. Grassland ecophysiology and grazing ecology. CABI Pub., New York.

Mannetje, L. t', and R.M. Jones. 1992. Plant resources of Southeast Asia 4: Forages. Prosea, Bogor, Indonesia.

Mannetje, L. t', and R.M. Jones. 2000. Field and laboratory methods for grassland and animal production research. CABI Publishing, New York.

Marten, G.C. et al. 1989. Persistence of forage legumes. American Society of Agronomy, Madison, WI.

Minson, D.J. 1990. Forage in ruminant nutrition. Academic Press, Harcourt Brace Jovanovich, New York.

Moser, L.E., B.L. Burson, and L.E. Sollenberger. 2004. Warm-season (C_4) grasses. ASA/CSSA/SSSA, Madison, WI.

Nelson, C.J. (ed.). 2012. Conservation outcomes from pastureland and hayland practices: Assessment, recommendations, and knowledge gaps. Allen Press, Lawrence, KS.

Sotomayor-Rios, A., and W.D. Pitman. 2001. Tropical forage plants: development and use. CRC Press, Boca Raton, FL.

Wedin, W.F., and S.L. Fales. 2009. Grassland: Quietness and strength for a new American agriculture. ASA/CSSA/SSSA, Madison, WI.

Course Requirements:

1. Regular attendance at class meetings (in person or online).
2. Completion of two exams (11 October and 1 December). Exams will cover material from the lectures and related discussions indicated in the class schedule.
3. Completion of 10 reading briefs.
4. Lead one 20-minute classroom discussion and regularly prepare for and participate in classroom discussions
5. Complete a group term project and present it in written and oral forms.

Grading:

There will be a total of 400 possible points. The basis for assigning grades is indicated below. The grading scale may be lowered, but you are guaranteed at least the grade listed if you obtain the appropriate number of points.

Item	Points	Total Points	Grade
First exam	100	372-400	A
Second exam	100	364-371	A^-
Reading briefs	50	356-363	B^+
Discussion leadership	20	348-355	B
Discussion participation	30	336-347	B^-
Term project	100	320-335	C^+
Total	400	308-319	C
		292-307	C^-

Reading Briefs:

The purpose of the reading briefs is to provide a framework that encourages greater synthesis of the assigned readings by the students and greater integration of this content into the course by the instructor.

Reading briefs will be due the day the content will be discussed in class. Each student must submit at least 10 reading briefs via Canvas during the semester. Assigned readings will be made available at least one week in advance of the day that they will be discussed in class and when the reading brief will be due. There will be more than 10 assigned readings (> 20), so you need submit only a subset of the possible reading briefs. Briefs will be graded on a scale of 0 to 5 points each. In nearly all cases, your brief will be a response to questions I pose for you to answer based on your reading of the assignment.

Reading brief assignments will be posted on Canvas, and your brief should be submitted using Canvas. In most cases, a one-page response (double spaced text, 12-point font) will suffice. You can choose the readings from which you wish to prepare a brief, so long as by the end of the semester you have submitted at least 10. If you submit more than 10, I will count only the 10 highest scores. Remember that the briefs are due by class meeting time the day of the lecture on that topic.

Discussion Leadership and Participation:

During some class periods we will have a designated period for group discussion. Each student must lead one discussion during the semester. The intent is that you choose the content for which you wish to lead the discussion, based on the topic being covered. The discussion will be based on the paper(s) I have assigned for that specific lecture, or alternatively you may choose to

discuss one or more related papers you have found. If you choose a non-assigned paper or papers, they must be made available to the instructor at least one week in advance of the discussion period so that they can be distributed to the other members of the class. **Please note that a discussion is not a lecture**. The leader is asked to prepare a series of thought-provoking questions or prompts for the group that will direct the discussion and help to draw out the most important points in the paper. The remainder of the class will be expected to respond to your questions with informed discussion based on having read the assigned papers. Twenty points will be awarded based on your leadership of the discussion period, and 30 points will be allocated based on your participation in discussions during the entire semester.

Grassland Agroecosystems Project:

*Objective***:**

To compare a "control" grassland-livestock system with an "alternative" system in terms of delivery of ecosystem services and potential environmental impacts in order to develop a rational (and minimally quantitative) assessment of the relative sustainability of the alternative vs. the control system.

General Description:

The class will be divided into four or five groups, depending on number of enrollees, attempting to balance discipline interests as well as level of training. Students will be asked to express their ranked preferences of which alternative system group they wish to be part of. These preferences will be honored to the extent possible in assigning students to groups. The groups will remain intact throughout the Fall semester and each group will be assigned one alternative production system that will be compared with a control system. Each group can describe an appropriate control for their environment, but to achieve some level of uniformity across groups the control systems should be based on forage grasses only (no legumes, no row crops, no trees for commercial purposes). The control should be managed at a low (no greater than the regional average)-input level for that region, with cattle as the animal and the primary product being either meat or milk. Nitrogen fertilizer rate is a useful guide to management intensity of the control system.

Each group can select the location where their system (and the control) will be located. Before choosing a location, make sure it is one for which there is a large amount of information available about the soils, climate, and production system. It is likely that time limitations or limited access to information will force us to accept some gaps in our system descriptions, but we want to push the limits and take the exercise as far as we can. You are welcome to choose a site in Florida if you wish. You can choose the exact amount of land you are working with, but I suggest a minimum of 20 ha and a maximum of 500 ha.

Systems:

1. Systems (groups will have one system, i.e., System b, c, d, e, or f below; compare your system with the control)
    a. Control – grass-based using introduced species; warm-season perennials and cool- or warm-season annuals if you like, but you choose the species (no legumes, no row crops, no marketable trees); level of nitrogen fertilizer is average for the region (expected to be relatively low)
    b. Native range – the vegetation composition will depend on the location chosen, but the assumption is that you will be using all native/naturalized species and not ones that have been planted in recent history; you design the management system but it is assumed that inputs will be extremely low (unfertilized, no pesticides, no irrigation, etc.)
    c. Intensive – grass-based; warm-season perennials and cool- or warm-season annuals, you choose the grass species (no legumes, no row crops, no marketable trees) – assumption is that nitrogen fertilizer inputs will be considerably greater than the Control
    d. Legume – warm- and/or cool-season annual or perennial legumes integrated into the production system; can choose to have areas without legumes if you wish, but you are limited to no more nitrogen used on the total farm than on the Control farm
    e. Integrated crop-livestock – forages and row crops of your choosing (any species or mixtures that you want to use that are regionally adapted) with amount of area allocated to each at your discretion; no more than 2x the Control rate of nitrogen fertilizer on areas growing forage; row crop component receives recommended amount or some part assumed to derive from the previous forage component
    f. Silvopasture – tree species and planting pattern of your choice; don't need to have trees on every area; forage pasture species and amount of area at your choice; no more than 2x the Control rate of nitrogen fertilizer on areas growing forage

Project Products:

There will be oral and written presentations of your product. Your job will be to contrast your alternative system and the control system by addressing the key questions indicated below. You can gather information from any resource available (person, published information, extension documents), but be sure to cite your sources.

It is assumed that each member of the team will be involved in all aspects of the project but that individual members will assume more responsibility for elements of the work best aligned with their interests/expertise and should present that portion in the oral report. Your team grade (70 out of 100 points) is based on the quality of the overall project (oral and written components), the degree of organization and flow of the project, the integration of all team members into the execution of the project and its presentation. The individual grade (30 out of 100 points) will be

based on the instructor's evaluation of each individual's portion of the project as well as their oral presentation.

Key Questions to Answer:

1. Describe your production system (also describe your control system in terms of c-f below)
    a. Describe the general climate data for this area, i.e., total annual rainfall, average monthly rainfall, monthly average high and low temperatures, average date of first and last frost (if applicable).
    b. Describe the characteristics of this soil (texture, drainage, fertility, organic matter)
    c. Area allocated to each species (planting pattern or crop rotation as appropriate)
    d. Timing of operations (when particular species will be planted, growing, fertilized, harvested; calving and breeding seasons for livestock)
    e. Levels of N fertilizer input for each component of the system (to simplify we will not address irrigation, pesticides, other nutrients, etc.)
    f. Number of mature cows on your systems (this will be the presumed number of cow-calf pairs during the period when calves are nursing)

2. Describe the ecosystem services that your system provides (where possible put an economic value on these services, especially the provisioning services; contrast these ecosystem services with those provided by the Control system)
    a. Provisioning (animals or animal products sold, crops [hay or row crops; assume an average regional yield and price], trees, etc.)
    b. Regulating - Soil organic C, soil/livestock greenhouse gas emissions, water quality
    c. Supporting - Nutrient cycling in plant litter and excreta, N fixation
    d. Cultural - Wildlife viewing, hunting, etc.

3. Identify and quantify to the extent possible any negative environmental consequences associated with your system (do your best to find reasonable estimates of emissions or losses, do not need to express in monetary terms; compare these with the Control system)
    a. Greenhouse gas emissions (methane, nitrous oxide, CO_2)
    b. Soil erosion
    c. Loss of soil OM
    d. Nutrient leaching
    e. Nutrient runoff to surface water
    f. Wildlife habitat
    g. Pollinator habitat

4. If deemed appropriate, the groups should also consider and recommend societal/government incentives/policies that will be needed to make their system practical and economically sustainable.

In-Class Recording:

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited.

Specifically, students may not publish recorded lectures without the written consent of the instructor. A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Academic Honesty:

In the process of enrolling and registering for classes at the University of Florida, every student has signed and presumably understands the following statement: "I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University."

Student Evaluation:

"Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their

Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/."

Use of Library, Personal References, PC Programs, and Electronic Data Bases:

These items are university property and should be utilized with other users in mind. Never remove, mark, modify nor deface resources that do not belong to you. If you are in the habit of underlining text, do it only on your personal copy. It is inconsiderate, costly to others, and dishonest to use common references otherwise.

Software Use:

All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

UF Counseling Services:

I hope to establish a class relationship and encourage dialogue so that students feel comfortable discussing academic problems directly with me. In addition, resources are available on campus for students having personal problems or lacking clear career and academic goals, and whose academic performance is suffering as a result. These resources include:

1. University Counseling Center, 301 Peabody Hall, 392-1575 (personal and career counseling);

2. Student Mental Health, Student Health Care Center, 392-1171 (personal counseling);

3. Sexual Assault Recovery Services (SARS), Student Health Care Center, 392-1161 (sexual assault counseling); and

4. Career Resource Center, Reitz Union, 392-1601 (career development assistance and counseling)

Students With Disabilities:

Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the course instructor when requesting accommodation."

AGR 6233 - Tropical Grassland Agroecosystems

Class Schedule – Fall 2021

Month	Date	Topic
August	23	Course introduction Overview of Lectures 1-3 (highlighting of most important points; students should read through the lecture content outside of class) Lecture 1 - Description of warm-climate environments Lecture 2 - Centers of origin of tropical forages, plant introduction, and evaluation Lecture 3 – The importance of tropical grasslands
	25	Lecture 4 - Factors limiting livestock production in warm-climate grasslands Discussion - The future of grassland agroecosystems: What do we need and can it be achieved? Topics include multi-functionality, resilience, and landscape design
	30	Discussion - Is intensification the answer, and if so, what does it look like? Topics include sustainable intensification, species-rich grasslands, integrated crop-livestock systems, and silvopasture.
September	01	Examples of Grassland Systems Native Grasslands/Rangeland (Uruguay) Planted Grassland Monocultures (Brazil, Florida)
	07	Examples of Grassland Systems (Continued) (**NOTE**: This is a Tuesday meeting) Lecture 5 – Contributions of legumes to grass-based forage systems in warm climates Integrating Forage Legumes into Grass-Based Systems (Australia, Florida)
	08	Examples of Grassland Systems (Continued) Lecture 6 - The case for integration of crop and livestock production

		Lecture 7 – Examples of integrated food-crop and forage-livestock systems in warm climates (limited in-class time; read over outside of class)
		Integrated Crop-Livestock Systems (Brazil, Kenya)
	13	Examples of Grassland Systems (Continued)
		Lecture 8 - Silvopastoral Systems (Dr. Jose Dubeux)
	14	Lecture 9 - Leaf anatomy of grasses (**NOTE**: This is a Tuesday meeting)
	15	Lecture 10 - Carbon fixation pathways Lecture 11 - Nitrogen fixation
	20 and 22 – NO CLASS	
	27	Lecture 12 - Moisture effects on forage plant growth and development Lecture 13 - Temperature effects on forage plant growth and development
	29	Lecture 13 - Temperature effects on forage plant growth and development (continued) Lecture 14 - Light effects on growth, morphology, development, and seed production
October	04	Lecture 15 – Characteristics of tropical soils and plant responses to fertilization Lecture 16 - Nutrient competition and allelopathy among forage plants
	05	Lecture 17 – Excreta deposition and nutrient cycling (**NOTE**: This is a Tuesday meeting) Lecture 18 – Forage plant interactions with mycorrhizae
	06	Lecture 19 – Effects of shade on forage plants
	11	**Exam 1 – Lectures 1-19**
	13	Lecture 20 – Role of fire in grasslands Lecture 21 - Climate change and grassland ecosystems
	18	Lecture 22 - Ecosystem services of grasslands

		Discussion – Amelioration of greenhouse gases Discussion - Wildlife habitat and pollinators Discussion - Soil carbon
	20	Lecture 23 - Pasture establishment
	25	Lecture 24 - Animal effects on pastures: Defoliation, selection, and treading Lecture 25 - Plant-animal interactions and factors affecting intake
	27	Lecture 25 - Plant-animal interactions and factors affecting intake (cont.) Lecture 26 - Forage quality: Definition and factors affecting forage quality
November	01	Lecture 27 - Forage quality: Laboratory measures to predict forage quality Lecture 28 - Cell wall structure, composition, function, and role in forage utilization
	03	Lecture 29 - Forage antiquality factors
	08/10	**ASA/CSSA/SSSA Meeting – NO CLASS**
	15	Lecture 30 - Grazing systems and grazing management
	17	Lecture 31 - Grazing intensity and frequency
	22	Lecture 31 - Grazing intensity and frequency (cont.)
	23	Lecture 32 - Hay and silage production from C_4 Grasses (**NOTE**: This is a Tuesday meeting)
	29	Lecture 32 - Hay and silage production from C_4 grasses (cont.) Lecture 33 - Supplementation of forage diets and use of forage banks
December	01	**Exam 2 (Lectures 20-33)**
	06	Oral presentations of term projects
	08	Oral presentations of term projects