Pasture Management
Professional Development Workshop
2012 Syllabus

Western Region Sustainable Agriculture Research and Education Program (Western SARE)—Professional Development Program

Glenn E. Shewmaker, University of Idaho Extension Forage Specialist
Steven C. Fransen, Washington State University Extension Forage Specialist
Mylen Bohle, Oregon State University Area Extension Agronomist

Audience: College educated, more than 50% with advanced degrees in Agriculture or Biological Sciences. Assume basic plant biology understanding. Forage and pastures are very diverse subjects; we will focus on understanding key concepts rather than covering everything.

Course description: Discussion topics: importance and nature of forage and grassland resources; application of biological principles to growth, development, management, and use of cultivated forage plants as pasture and conserved feed; interaction of soils, plants, animals, and environment in forage-livestock systems; and design of sustainable grassland production systems. Learning will be through lecture, discussion, reading, problem-solving in field exercises, and exams. Reading assignments are designed to provide further information of interest after the seminar. Field and lab exercises and lectures will be complementary and interactive.

Course objectives: Students will learn the fundamentals of forage plant structure, growth, development, physiology, management, nutritional value, and contributions to agricultural sustainability. This will include i) how forage plants function and respond to their environment; ii) the integration of forage plants and livestock into systems; and iii) how to approach problems in forage and grassland management. Through lab and field exercises, students will gain understanding of the concepts and nature of scientific investigation. The course stresses principles and relationships, which can later be applied to specific cases in the design and management of sustainable forage-livestock systems.

Upon Completion the Participant will be able to:

- Explain some basic principles of forage cultivar development –
- Terminology and seed differences
- Seed production
- Describe basic anatomy, morphology, and growth cycle of grasses and clover or trefoil
- Describe practices for pasture establishment
- Identify issues in soil fertility and nutrient management unique to grass and mixed pastures
- Define the common forage quality terminology
- Recognize the impact of weeds on stand establishment and forage quality
- Identify common diseases and insect damage
- Explain basic principles of pasture management and relationship to stand longevity and productivity
- Define various harvesting and grazing systems
- Explain the value of legume mixes and diversity in pastures
- Provide training on the basic learning objectives
- Describe livestock nutritional needs from forage, and how to manage the system for animal performance
- Allocate forage on an annual basis

DAY 1

Lecture

Introduction (30 min)

- Brief introductions among participants and instructors
- Introduction to the course
- Pre-test

Genetics, Variety Development, and Species Selection (40 min lecture 10 min discussion)

- Process of how to lead clientele to selection of appropriate species and management package.
- Plants for Saline to Sodic Soil Conditions
- Grass, Grass-like, Forb, Legume, and Woody Species for the Intermountain West
- Clarify which species are self- vs. cross-pollinated.
- Ecozone, site specific information

Seed Classes, Quality, and Sources (30 minutes)

- Terminology
- Seed certification – breeder's, foundation, registered, certified
- Reference USDA NRCS Idaho Plant Materials Tech. Notes 4 (Reading Seed Packaging Labels and Calculating Seed Mixtures; PLS – What it is and How to Use it)
- Price versus value

Growth, Development, and Defoliation Responses of Grasses and Legumes
Physiology and defoliation responses. In terms of the jointed/non-jointed terminology, we recommend using long- and short-shooted species, because that best describes spp. with culmed vs. culmless vegetative shoots (technically the most descriptive, but complicated-sounding and probably meaningless to most). Discussion of how many live leaves a grass supports at one time (3-5, maybe 6 for some spp.) and relationships of the 3-5 leaf stage with high quality, high energy reserves and recovery capacity, and adequate root system. Discussion of grass endophytes including the novel endophytes in Ark Plus and Max Q, etc.

In grasses and legumes presentations: integrate compatibility and behavior of spp. in mixtures. At some point here or in Forage Quality, discuss differences between grasses and legumes in fiber and fiber digestibility.

- **Grasses (45 min lecture 15 min discussion)**
  - Seed germination
  - Developmental Morphology

Structure	Plants
Phytomers	Root Systems
Tillers	

  - **Tiller development and morphology**

Tillering	Tiller Longevity
Tiller Recruitment	Leaf

  - The role of carbohydrate reserves and photosynthetic capacity
  - Focus on morphology
  - Perennial, crown development, root development, carbohydrate storage
  - Ecophysiology

- **Legumes (45 min lecture 15 min discussion)**
  - Bunch vs. spreading types: which spp. rely more vs. less on reserves,

- reasons for bloating vs. non-bloating properties
- Inoculation and N2 fixation
- Sources and rates of regrowth after defoliation (continuing growth from protected apical meristems vs. axillary buds).

Irrigation and Water requirements (30 minutes)

Soil water holding capacity
Function of water in plants
Evapotranspiration
Water deficit effects
Rooting depth
Managing for drought, drought-induced dormancy

Lab/Field Exercises

Forage Seed and Seedling ID Exercises

Students will identify 13 grasses and legumes at the seedling stage with the help of keys; distinguishing characteristics at the seedling stage will be emphasized

Farm host: Pasture-livestock systems, challenges, and solutions (30 min.)
Cummings Center, 300 cow/calf pairs, John Hall

Plant ID and Morphology (45 min.):

1. Collect and ID 10 grasses and 3 legumes
2. Extract whole plant including first 18" of roots, Examine and name structures
3. Discussion of plant structure/morphology/defoliation response.
4. Have dissecting microscopes in classroom and bring hand lenses to field.

Measure sward characteristics: (1 hour)

Lab and Field Exercises should include marking some residual pasture heights at time intervals (e.g., 5, 10, 15 days before our tour) so that participants can document how much the pastures regrow, discuss variations in regrowth due to spp. and management, calculate pasture growth rates, and learn how to find what the grazing height was by using bite marks on stem bases and residual fully-elongated leaves. This would also include some herbage mass assessment with visual charts, sticks and RPMs, and clipped quadrats in flagged areas that we can return to a day later to actually label what the herbage masses were after we oven-dry samples. We also need to work with the participants on the current position and status (veg. vs. repro.) of apical meristems; were they retained or removed, and how rapid is the regrowth because of that. They also need to have some ability to determine whether residual stubble with leaves has potential for continuing leaf growth, or whether that potential is gone because ap. Meristems have shifted to reproductive status.

- Canopy height
- Herbage mass (above ground biomass)
    - Double sampling, clip and weigh
    - Tools:

4 frames and 4 clippers
paper bags
Pasture capacitance probes
Pasture Sticks
Soil probe
Scale
10 pasture sticks
Rising plate meters
Greenseeker

DAY 2

Lecture

Soils, Fertility, and Nutrient Cycling and Management (45 minutes)

- Have example soil series map and description from soil survey.
- Emphasize nutrient cycling and loss (mineralization, volatilization, leaching, and return), management, luxury consumption.
- Nutrient and Manure Management
  - Issues of manure management, manure injury, weed seed
  - Concentration zones
- Fertility issues related to pasture production
  - grass and legume fertility requirements
  - grass-legume balance
  - fertilizer rates and timing

Sustainable Systems (15 min.)

- Environmental benefits
  - Perennial versus annual crops
  - Contrast grazing versus haying
  - Wildlife, aesthetics, lifestyle
- Carbon sequestration
- Nutrient Cycling
- Sediment capture
- Riparian management
- Stewardship

Nutritional Needs of Grazing Animals and Forage Nutritional Value (30 minutes)

- Basic composition of DM
- Estimates of animal performance potential
- Problems with high ruminal degradability of CP
- Role of tannins in reducing this, and how most of our conventional forage quality analyses do not address intake potential under grazing.
- Fiber digestibility among other constituents, and make a case for forage production being more for energy than for protein and how our evaluation schemes should reflect that.
- Terms and definitions
- Not necessary to go into the methodology of these assays but rather just define the terms
- Factors affecting quality
  - Composition and nutritive value of forages
  - Methods of evaluating forage quality
  - Environmental and management practices affecting forage quality
  - Forage-caused animal stresses
- Seasonal dynamics

Insect and Vertebrate Pest Management (30 min.)

Display images of a few pests as examples of different management strategies. Perhaps emphasize plant-livestock disease pest cycles and management. Have field handouts of pest management resources rather than in lecture. Have local field expertise for help with identification of insects, weeds, and pathogens.

- Insects
- Rodents
- Parasites: grazing effects on life cycles

Invasive Species and Weed Management (60 min.)

- Weeds
- Herbicides for forage weed management
  - Seedings
  - Established forages
- Poisonous plant ID and management

Establishment and Interseeding (30 minutes)

1. Factors involved in getting a good stand established
   - Choosing forage crops to seed
   - Stand establishment options/rationales – pure stand, mixtures, nurse crop, fall vs. spring
   - Principles of compounding forage and range mixtures
   - Forage seeding techniques

   1. Seedbed preparation
      a. clean seedbeds
      b. mulch seedbeds
      c. sod seeding
      d. range interseeding

   2. Seeding practices
      a. time of seeding
      b. rate and depth
      c. equipment
      d. companion crops
      e. Mixing Seed with Rice Hulls
      f. post seeding management
      (Pasture and Range Seedings; Planning-Installation-Evaluation)

   3. Nitrogen fixation and legume inoculation
   4. Clear seeding

Optimizing Net Carbohydrate Assimilation (30 minutes)

Pull together the pieces of integrated pasture-livestock systems for the first time and to discuss management opportunities to capture solar E and convert it to livestock products. Grass and legume growth stage/leaf area for high forage production and recovery, high quality for those animals that need it, residual leaf area or mass for high intakes and rapid recovery, seasonal growth distribution, differences among spp. in reliance on reserves vs residual leaf area for regrowth, what to do when forage supply and livestock consumption are not in balance (under- and over-stocking), and the concepts of what to stockpile or mechanically harvest vs. keep in the grazing rotation.

- Include LAI, leaf number/tiller for grazing readiness (see for example L.R. Turner et al. 2006. Effect of defoliation management, based on leaf stage, on perennial ryegrass (Lolium perenne L.), prairie grass (Bromus willenowii Kunth.), and cocksfoot (Dactylis glomerata L.) under dryland conditions. 1. Regrowth, tillering and water-soluble carbohydrate concentration. Grass For. Sci. 61:164-174.; T. Griggs has a few other papers on this); plant requirements for, and responses to, grazing; and overall management of plant energy balance.
- Photosynthesis, light interception
- Respiration
- Net Assimilation

Integrating Fence and Livestock Water Developments, Irrigation, and Livestock Management

- Planning layout and design of grazing systems
- Permanent facilities
  - Water development
  - Number of paddocks necessary

- Center pivot layout
- New fencing technology

Lab/Field Exercises

Tour of Eagle Valley Ranch (tentative)

Eagle Valley Ranch: Description of ranch management (30 min)

Forage inventory and using the grazing wedge (30 min)
Description of forage inventory methods, and using the grazing wedge in livestock forage allocation at Eagle Valley Ranch

Optimizing Net Carbohydrate Assimilation (30 min.)
Demonstration of instruments and methods to determine light interception, leaf area index, and net photosynthesis

Stocking Rate, Carrying Capacity, and Animal Performance (30 min.)
Practical use of determining stocking rate, etc.

Weed Management (30 min.)
Identifing weed problems and how to integrate pest management with grazing management

DAY 3
Lecture

The Sins of Over-Grazing (30 min.)

- "Pasture-Pastor" Fransen will make us believers
- The importance to consider the vigor of the plant and recovery after grazing

Grazing Systems (30 min)

- Setting animal performance and production targets and how that in conjunction with spp. Characteristics
- Opportunities or constraints for varying stocking rate lead to choice of cont., rotational, first-last, etc. systems.
- Appropriate pre- and post-grazing growth stage/herbage mass/leaf area to meet plant and animal performance and production targets.
- Discuss the #1 challenge in grazing mgt. of balancing forage supply and demand
- Integrating mechanical conservation and stockpiling with grazing.
- Continuous
- Rotational

Applications of Behavioral Principles to Pasture and Grazing Management (50 min.)

- Ruminants have evolved to be efficient consumers of fibrous grasses and forbs. To achieve this efficiency, livestock must have abundant forage of suitable quality available.
- Animals learn from their mothers and later from their peers what plants and plant parts to select for a good nutritional regime.
- Humans can positively or negatively influence animal behavior and subsequently livestock production.

Economics: Making Pasture Pay (1 hour)

- Moving from continuous to managed grazing increases forage availability, opportunities and potential profitability
- Knowing cost of production is critical
- How do increased stocking rate, extended grazing season and other factors impact your economics?

Elements of Management Intensive Grazing (50 min)

- Matching forage supply with the animals
- Uses of other resources
    - Annuals: rotation
    - Purchased forage
    - Rangeland

Lab/Field Exercises

Allocating Forages and Observations of Grazing Since Day 1 (50 min.)

Monitoring Pastures (30 min.):

- Discussion of ecological processes
- Biodiversity, benefits and disadvantages
- Use form to evaluate pasture

References

1. Course texts:

Shewmaker, G.E. and M.G. Bohle (eds.). 2010. Pasture and Grazing Management in the Northwest, PNW Bulletin 614, University of Idaho Extension, Moscow, ID. (208 pages)

Shewmaker, G.E. 2004, (ed.) Idaho Forage Handbook, Bulletin 547, University of Idaho Cooperative Extension, Moscow.

2. Reference texts:

R.F. Barnes, D.A. Miller, and C.J. Nelson, eds. 1995. Forages. Vol. I: An introduction to grassland agriculture. 5th ed. Iowa State University Press, Ames.

R.F. Barnes, D.A. Miller, and C.J. Nelson, eds. 1995. Forages. Vol. II: The science of grassland agriculture. 5th ed. Iowa State University Press, Ames (on reserve).

H.N. Wheaton and L.E. Anderson, compilers. Grass and legume identification. Reproduced from H.B. Hartwig's Pictures and aids to legume and grass identification, Vols. 1 and 2. Cooperative Extension Service, University of Kentucky College of Agriculture.

Dahl, B.E. 1995. Developmental Morphology of Plants p. 22- In: D.J. Bedunah and R.E. Sosebee, eds, Wildland Plants: Physiological Ecology and Developmental Morphology. Society for Range Management, Denver, CO.

Rayburn, Edward B (Ed.), 2006, Managing and Marketing for Pasture Based Livestock Production, NARES-174, Natural Resource, agriculture and Engineering Service, Cooperative Extension.

3. Readings from these and other supplemental materials:

A.L. Hafenrichter et al. 1968. Grasses and legumes for soil conservation in the Pacific Northwest and Great Basin states. Agriculture Handbook 339. Soil Conservation Service, USDA, Washington, DC.

J. Hodgson. 1990. Grazing management: science into practice. John Wiley and Sons, Inc., New York.

Dale Smith, R.J. Bula, and R.P. Walgenbach. 1986. Forage management. 5th ed. Kendall/Hunt Publishing Co., Dubuque, IA.

A. Voisin. 1959. Grass productivity. Philosophical Library, Inc., New York, New York.

R.E. Blaser et al. 1986. Forage-animal management systems. Virginia Agric. Exp. Stn. Bull. 86-7. Virginia Polytechnic Institute and State Univ., Blacksburg, VA.

4. Journal articles

5. Occasional class handouts.

6. Other resources:

Forage Information System on the World Wide Web: http://forages.oregonstate.edu/
Hoard's Dairyman: www.hoards.com
University of Idaho Forages: http://www.extension.uidaho.edu/forage/