27th Annual

February 22, 2011
University Plaza Hotel
Springfield, Missouri

Welcome to the 27th Annual Southwest Missouri Spring Forage Conference

This year marks our 27th Annual Southwest Missouri Spring Forage Conference. Having worked in the Missouri forage management arena for 30 plus years, I can truly say the SW Missouri Spring Forage Conference is one of the most popular and beneficial educational programs offered in the state specifically targeting forage producers. It is even recognized and envied in other states and regions. From its inception in the early 1980s, this conference has grown from about 50 attendees to more recent attendance numbers averaging around 400.

Our keynote speaker is Jim Lents of Indiahoma, Oklahoma. Jim is experienced in the focused breeding of cattle to emphasize ecological, genetic and economic sustainability. The title of his topic during the lunch break will be, "***IN SEARCH OF SUSTAINABILITY***". He will then be available for a follow up question and answer session.

In addition to the keynote address, we have organized four break-out sessions for you to attend covering a wide selection of topics. These topics, decided largely based on conference evaluations from recent years, present varied information tools to improve and maintain your forage base. I am particularly excited about the various concepts of grazing management, the most economical of all your forage practices. The goal of the SFC committee is to present a broad range of topics related to grazing agriculture. This does not constitute an endorsement of all the views and opinions for the speakers or vendors. We hope you will find those you are able to attend, educational and that you are able to take information back to benefit your own forage operations.

Between each break-out session and before and after lunch, please make sure you take time to visit the Trade Show. We have 30 to 40 vendors available for you to view and discuss their services and/or products.

Each year, the Planning Committee strives to improve upon our previous conferences. This year is no exception. We sincerely appreciate your comments and ask that you take a few minutes to complete the conference evaluation before leaving today.

A conference of this size requires the help of many individuals and organizations. The Spring Forage Conference planning committee is a partnership of the USDA Natural Resources Conservation Service, Soil and Water Conservation Districts of Southwest Missouri, University of Missouri Extension, USDA Farm Service Agency, Missouri State University Agriculture Department, University of Missouri Southwest Research Center and the Missouri Department of Conservation.

Our many thanks go to the vendors, break sponsors, conference speakers and especially the producers for making this a quality conference. Thanks also to the Conference Planning Committee for their dedication and hard work involved in planning and conducting this year's conference and doing so as an additional function beyond their everyday job.

If you have any questions or comments during the conference, all committee members will be wearing tan shirts displaying the Spring Forage Conference logo. We will be more than willing to help you.

We hope you have an enjoyable day and are able to build on the information and ideas presented to enhance your own businesses!

Sincerely,

Myron Hartzell
2011 Chair, SW Missouri Spring Forage Conference

27th Annual Southwest Missouri Spring Forage Conference

Tuesday, February 22, 2011
8:00-8:45 am
REGISTRATION & VISIT TRADE SHOW

8:45 - 9:30 -- CONCURRENT SESSIONS A
(Select one of these four sessions to attend)

(A1) Understanding & Improving Soil Function in Grazing Systems
(REPEATED at 2:45 pm)
Ray Archuleta, Conservation Agronomist
NRCS, North Carolina

(A2) Forage Diversity **(REPEATED at 2:45 pm)**
Dr. Rob Kallenbach, State Forage Specialist
University of Missouri, Columbia, MO

(A3) How to Strip Graze
Dr. Richard Crawford, Superintendent
MU SW Research Center, Mt Vernon, MO

(A4) Grazing Systems For Small Ruminants
Dr. Jody Pennington, Small Ruminant Specialist
Lincoln University Extension, Neosho, MO

9:30 - 10:15 am -- BREAK & VISIT TRADE SHOW

10:15 - 11:00 -- CONCURRENT SESSIONS B
(Select one of these four sessions to attend)

(B1) Selection & Management Practices for Producing Grass Type Cows-
(REPEATED at 2:45 pm)
Gearld Fry, Independent Bovine Engineering Consultant,
Rose Bud, Arkansas

(B2) Using High Stock Density to Improve Soils and Increase Profits
(REPEATED at 2:45 pm)
Mark Brownlee, Producer, St Clair County, MO

(B3) Various Grazing Philosophies, Producers' Experiences -- 3-leaf Stage ; Take ½/Leave ½ ; High Density --
Steve Freeman- Producer, Wright County, MO
Dr. Stacey Hamilton- Dairy Specialist,
MU Extension, Mt Vernon, MO

(B4) Going Beyond the Spray Boom for Grassland Weed Control
Tim Schnakenberg- Agronomist
MU Extension, Galena, MO

11:00 - 11:45 am
BREAK & VISIT TRADE SHOW

11:45 -- LUNCHEON

Emcee – Dr. Anson Elliott, MSU School of Agriculture

Keynote Address

"IN SEARCH OF SUSTAINABILITY"

Jim Lents

Rancher - Indiahoma, Oklahoma

1:15 - 1:45 pm -- BREAK & VISIT TRADE SHOW

1:45 - 2:30 -- CONCURRENT SESSIONS C

(Select one of these four sessions to attend)

(C1) Question & Answer Time with Keynote Speaker

Jim Lents, Rancher, Oklahoma

(C2) Manage What You've Got Before You Buy That "Silver Bullet"

Mark Green, District Conservationist
NRCS, Springfield, MO

(C3) Litter vs. Commercial Fertilizer

Dr. John Lory, Associate Professor, Plant Science
University of Missouri, Columbia, MO

(C4) How to Harvest Quality Hay in SW Missouri

Bill Garrett – Producer, Barton County, MO
Allan Trantham – Producer, Greene County, MO **I**

2:30 - 2:45 pm -- BREAK

2:45 - 3:30 – CONCURRENT SESSIONS D

(Select one of these four sessions to attend)

(D1) Understanding & Improving Soil Function in Grazing Systems

Ray Archuleta, Conservation Agronomist
NRCS, North Carolina

(D2) Selection & Management Practices for Producing Grass Type Cows

Gearld Fry, Independent Bovine Engineering Consultant
Rose Bud, Arkansas

(D3) Forage Diversity

Dr. Rob Kallenbach, State Forage Specialist
University of Missouri, Columbia,MO

(D4) Using High Stock Density to Improve Soils and Increase Profits

Mark Brownlee, Producer, St. Clair County, MO

3:30 pm ADJOURN

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Southwest Missouri Spring Forage Conference
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The Southwest Missouri Spring Forage Conference is brought to you by these university and agency sponsors.

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Trade Show Vendors

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Jasper County	417-358-8198
Lawrence County	417-466-7682
Newton County	417-451-1007
Polk County	417-326-5993
St. Clair County	417-646-8108
Stone County	417-723-8389
Webster County	417-468-4176
Wright County	417-741-6195

26th Annual
Southwest Missouri Spring Forage Conference
Speaker Biographies

Ray Archuleta, Conservation Agronomist, USDA/NRCS East National Technology Center, in Greensboro, North Carolina. Ray Archuleta is a Conservation Agronomist at the NRCS East National Technology Center, in Greensboro, North Carolina. Ray has 23 years of work experience with the Natural Resources Conservation Service. He has worked for NRCS in New Mexico, Missouri, Oregon, and now lives in North Carolina and has held the following positions: Soil Conservation technician, Soil Conservationist, Nutrient/Irrigation Specialist, Water Quality Project Manager, District Conservationist, and Area Agronomist. He is also a Certified Professional Soil Scientist with Soil Science Society of America. He also served two years in Guatemala working as Livestock Specialist in the Peace Corps. He received his B.S. in Agricultural Biology from New Mexico State University. *Topic: Understanding & Improving Soil Function in Grazing System*

Mark Brownlee – Technician for St. Clair County, MO Soil and Water Conservation District- Mark was raised on a beef, dairy, hog, and row crop farm near Lowry City, MO. The value of diversity was taught at an early age. After high school he stayed on the family farm. In 1987 Mark took a part time job as a technician with the soil and water conservation district. The SCS district conservationist in the office at that time tried to explain New Zealand rotational grazing to Mark. His response was that nobody was dumb enough to go move cows from one pasture to another that often. A few years later a young soil conservationist named Doug Peterson came to work in the St. Clair co. office and after MANY discussions finally convinced Mark to try rotational grazing. Over the years the dairy and swine operations had been dropped when those enterprises dropped below the profit level. So in 2008 when soaring fuel and fertilizer costs threatened the profitability of his beef operation that relied heavily on commercial fertilizer and baled hay, Mark knew some changes were going to have to be made to either cut or eliminate some input costs. While considering several options he attended a seminar on high stock density grazing. After much deliberation the decision was made to try high stock density grazing starting in May 2008. After using this method for 3 years Mark continues to be impressed with how high stock density grazing has improved plant populations, plant diversity, reduced the threat of summer drought, and decreased winter feed costs and completely eliminated fertility expenses. *Topic: Using High Stock Density to Improve Soils and Increase Profits*

Dr. Richard Crawford, Jr., Superintendent, Univ. of Missouri SW Center - Dr. Crawford grew up in New York State and received his BS degree in Animal Science from Cornell University in 1974. In 1978 he received a MS degree in Animal Science from the University of Maine, followed by a Ph.D. in Animal Nutrition from West Virginia University in 1983. He began his career at the SW Center in 1983 as a Research Associate with the Dairy Science Department. After a time as a Research Assistant Professor with the Agricultural Experiment Station, he was appointed Interim Superintendent of the SW Center in 1993, and Superintendent in 1994. Dr. Crawford supervises all animal research at the Center, including grazing studies, feeding trials, new drug and product evaluations, tall fescue/endophyte trials, backgrounding steers, dairy heifer development, etc. He's also involved in forage variety, management and fertility studies. *Topic: How to Strip Graze*

W. Anson Elliott, Head, William H. Darr School of Agriculture, Missouri State University -
Educational History:

- Houston High School - Valedictorian of the class of 1961 (87 graduates)
- University of Missouri, Ph.D. in Plant Breeding 1972

Professional Positions Held:

- Assistant Professor of Agronomy and Plant Genetics, University of Minnesota-St. Paul, St. Paul, MN, 1972-1978
- Administrator of the Agriculture Program, Missouri State University, Springfield, MO, 1980-present

Professional/Leadership Activities:

- Budget and Advocacy Committee Member for the Agriculture Colleges in the US. 2004 - present

- President of the Non Land Grant Colleges of Agriculture in America, 1990-1991 and 1993-1994
- Agriculture Advisory Committee of Governor Blunt, Senator Bond, and Congressman Blunt

Awards:

- The National Association of College and Teachers of Agriculture Distinguished Educator Award – 1998
- Mo. Agriculture Leader of the Year Award as presented by the Agriculture Leader of Tomorrow Organization – 2006

Responsibilities:

- Administrate the William H. Darr School of Agriculture programs at Missouri State University which includes the Darr Agricultural Center, the State Fruit Experiment Station and the Journagan Ranch.
- Taught a variety of classes in Agronomy and Agricultural Issues facing Society. A Forage Class that often served over 70 students per year for nearly three decades have been among the favorite subjects taught.

Research/Publications:

- Developed the first Wild Rice variety at the University of Minnesota named Netum, meaning "first" in the Chippewa language
- Several publications, including a chapter in an American Society of Agronomy book on the hybridization of crops

Topic: Emcee

Steve Freeman, manager/owner of Woods Fork Cattle Company LLC, Wright County MO- Steve began farming with his wife, Judy, on a small farm in Wright County, Missouri in 1978. In 1987 they purchased their present farm and began farming full-time. Their first MiG system was installed in 1987 and cattle, grazing and grass have been their focus for the last 24 years. Steve and Judy are charter members of the South Poll Grass Cattle Association and use this breed of bulls, as well as Beefmaster bulls purchased from the Lasater Foundation herd. Steve says, "the grass/livestock business is really a simple business, but it seemed like I had to make it more complicated before I could learn how to keep it simple. It takes time to learn what's important and what isn't, and this learning process never ends". The Freeman's host farm tours and grazing schools at the farm and feel it's very important to be 'grazing advocates'. "People are beginning to understand how important grass and proper grazing can be in helping our world be a better place to live and it's a real honor to have a chance to be a very small part of this", says Steve. *Topic: Various Grazing Philosophies, Producers' Experiences*

Bill Garrett, Garrett Farms- I have been in the hay business for thirty-five years. We have lived on our current farm in Barton County since 1994. We now try to bale between 4000 to 6000 acres per year consisting of alfalfa, alfalfa-orchard grass, brome, prairie, crabgrass,fescue, and straw. As our alfalfa acres are being rotated and replaced, we also bale quite a bit of lespedeza. Lespedeza has made a very good horse and goat hay.

We switched to the midsized square bales in 1998. We currently use two 3x3x8 square balers, two 4x6 round balers, and two small square balers for the straw. We also bale and wrap high moisture hay for silage. This allows us to keep ahead of the weather and retain quality, not allowing it to get too mature.

We still have to purchase approximately one half of all the hay we sell as the weather in southwest Missouri makes it difficult to expand our operation any larger than we currently are.

We sell a lot of hay at the barn, but most is delivered to customers by the semi load. We have customers in several states, some have bought hay from us for over fifteen years. It is a year round business. *Topic: How to Harvest Quality Hay in Southwest Missouri*

Gearld Fry, Producer & Independent Bovine Engineering Consultant- Gearld Fry is considered a revolutionary by some, but actually his journey to the top of the grass fed beef industry was evolutionary…measured, natural and inevitable.

Gearld was just seven years old, a little boy on the family farm near Rose Bud, Arkansas when he was assigned his first milking cow. By the age of 14, he had purchased his first steer and was showing it around the state. Too poor to purchase a top bull, he taught himself artificial insemination.

By then, Gearld's eye had taught him pretty well what to look for in outstanding livestock and he had developed the habit of listening to the old-time cattlemen. But like all farmers, he had been educated in the grain-fed paradigm and dutifully chased the "bigger is better" philosophy. It wasn't until he established his own Reproductive Center that the doubts began to grow.

Fry says now that it was quickly apparent that many of the so-called "top bulls" had poor quality semen and many of the "best cows" had trouble getting pregnant. He began doing his own research, using blood analysis, and determined that the proper nutrition designed for that animal was the answer.

Knowing he was on to an important breakthrough, he widened his circle of contacts and began reading literature from centuries ago. He concluded that grain should not be fed to a herbivore, but found he was virtually alone in that view. The scientific research of his day was totally dominated by the feed lot paradigm. No one was interested in what grain feeding, much less antibiotics and hormones, were doing to the vigor of American cattle herds.

Fry did discover a few men who confirmed and broadened his own observations; men whose conversations and writings educated him in the mysteries of genetics, immune function, embryonic development and the functionality of the bovine.

The first was Dr. Richard (Dick) Saacke, Professor Emeritus of Reproductive Physiology at Virginia Tech State University. Dr. Saacke educated Fry in the affect of nutrition on embryonic development, optimization of semen preservation, improving reproductive efficiency and understanding the importance of hormonal balance and activity and its affect in both male and female.

The second was Dr. Jan Bonsma of South Africa. It was Dr. Bonsma, says Fry, "who eliminated all my cowboy-isms". Bonsma who taught Fry to look at the gland system, examine the hide and bone structure, and allow the cow's outward expressions tell him what was happening under the hide.

Fry's reading took him back to the 17th and 18th century and the writings of Robert Bakewell of England and Francis Gynon of France. From their writings he begin to understand the importance of line-breeding---breeding the best to the best (consistency)---and the importance of the escutcheon in mirroring the butterfat and milk potential of the cow, important for both milk and meat. He also acknowledges a debt to the research of Dr. Weston A. Price and Dr. Francis Pottenger for their work in diet and health.

Fry's own writings have appeared in many agricultural journals and in 2003 he authored "Reproduction and Animal Health", which is a guide to selecting, breeding and managing a herd for health and performance on grass.

It was a fortunate coincidence that the consumer demand for healthy, natural food exploded about the time that Fry arrived on the national scene. He was among the first to argue that grass fed beef was the answer to the dangerous feed lot system that grew out of the corn glut after World War II. A search for the right cow to fit the new (really old) grass fed paradigm led him across the United States and to Australia and New Zealand, where he finally settled on the Ruby Red Devon.

With Fry's advocacy, interest in the pure bred Devon launched a renaissance in the breed which once had been at the forefront of American cattle. Close to being placed on the Endangered Species List, Devon today top the list of desired grass fed animals thanks to Fry's founding of both Bakewell Reproductive Services and the North American Devon Association, of which he is president.

Coupling the writings of men he acknowledges as "the old masters" with his own 40 years of owning and observing cattle around the country, Fry has assumed a position of leadership in the art of cattle selection, management and genetics to prosper in a natural, totally grass fed environment. Today his passion remains to educate cattle producers in producing healthy, quality beef for the benefit of the American consumer. *Topic: Selection & Management Practices for Producing Grass Type Cows*

Mark Green, District Conservationist, USDA-NRCS Greene County, MO- Mark Green, District Conservationist, USDA Natural Resources Conservation Service (NRCS), Springfield, MO. Mark was born in Scottsbluff, Nebraska and was raised on a ranch southwest of Denver, CO. He received his Bachelor of Science Degree in Agronomy from Southwest Missouri State University in 1983. Mark has worked for the SCS/NRCS since 1981. He has worked as Soil Conservationist, Area Resource Conservationist and District Conservationist for SCS/NRCS. He has been serving in Greene and Webster Counties in SW Missouri since 1994. He also worked in Caldwell County in NW Missouri early in his career. Prior to working for NRCS Mark worked for Haubien Farms at Lockwood, Missouri. Other jobs prior to college included Beechwood Ranch, Joplin, MO; Corder Ranch, Avilla, MO and Limon, CO; Deer Creek Valley Ranch, Pine, CO. Mark grew up in a ranching family in Colorado. Currently Mark serves as an instructor and regional coordinator for SW Missouri Regional Management-Intensive Grazing Schools. Mark is a member of Society for Range Management, American Forage and Grassland Council and is a Board Member for Missouri Forage and Grassland Council. Mark has worked with grazing management in SW Missouri for the past 29 years. He has been married to Jill for 32 years and has three grown children. One grandchild on the way. *Topic: Manage what You've Got Before you Buy that "Silver Bullet"*

Jim Lents, Rancher, Indiahoma, OK- I was born and raised in SW Oklahoma near the small town of Indiahoma. My father engaged in the breeding of purebred Hereford cattle and the construction of custom homes, and during my youth I acquired the necessary knowledge and skills to successfully engage in both occupations. In addition my college degree enabled me to engage in the commercial banking business.

I met my wife Nancy while we were students at Oklahoma State University, we were married a year after my graduation and are now approaching our 44th wedding anniversary. We have two children, both sons. Clay, our oldest, is a research scientist at USDA Meat Animal Research Center at Clay Center, Nebraska. Our youngest, Ross is completing a practicum in Clinical Psychology in Edmond, Oklahoma in preparation for private practice. Clay's wife is Angela and Ross's wife is Beth. We have two grandchildren Austin age 5, and Tajel age 2.

While I've had three mini-careers in banking interlaced with two mini-careers in home construction, my passion and primary pursuit has always been the breeding of purebred Hereford cattle; more specifically, the linebreeding of purebred Hereford cattle. This experience has firmly convinced me of the superiority of this breeding methodology relative to the other three methods of breeding available to mankind. From my earliest memory I've been connected to the Linebred Anxiety 4th family of Herefords. Foundation stock of this durable genepool began arriving at the Lents Ranch six weeks before my birth, and have now been in occupancy here for 67 years. At an early age I was drawn, perhaps even called to the business of preserving and perpetuating this closed Linebred genepool of stock now 130 years in the making.

From an early age I was allowed to accompany my father to Hereford sales and other events. The places we went were principally those connected to and involving Linebred Anxiety 4th Hereford cattle, then the dominant factor in the Hereford breed in America. In the process I became acquainted with virtually every Anxiety Hereford breeder of consequence. But perhaps most importantly I got to know Henry and Bob Mousel who in 1916 had acquired the heart of the Anxiety genepool from Gudgell & Simpson who'd imported the bull Anxiety 4th and 100 cows from England and founded the genepool in 1881. In assembling the foundation of his herd in the 1940's, my father focused exclusively on Mousel bred cattle. His first Anxiety 4th animal was purchased from Henry Mousel on January 27, 1944. Others seed followed until Henry's death in 1960 when I was 16 years old.

When I was 10 years old I started collecting information and material on Herefords. In the years since, it's grown into the largest collection of historical material and memorabilia on Hereford cattle in North America. The curriculum for my linebreeding education consisted of this material, word of mouth information from my father and other older breeders, particularly Mousel Brothers and their sons, observation of the work of others, and my own personal experience as a breeder the past 55 years.

When I was first approached about speaking at this conference I considered some possible topics. It's my firm belief that one should only deliver speeches on things they have a right to talk about by virtue of their own experiential base. The topic I've chosen is "sustainability" because it's a critical issue in agriculture, and I know that there's a direct link between linebreeding and sustainability. We'll explore the components of sustainability, the two biggest lies ever told in

the beef industry and their negative impact on true sustainability. The title for my talk is **In Search Of Sustainability.** I think you'll find it of interest. *Topic: Main Speaker In Search of Sustainability*

John Lory, Ph.D. Associate Professor, Plant Science Division, Commercial Agriculture Program, University of Missouri- John's program is focused on nutrient management planning, decision support tools for nutrient management, phosphorus loss from agricultural fields, impact of proposed regulations on concentrated animal feeding operations and applied predicting fertilizer need of crops on fields receiving animal manure. Key products include the Spatial Nutrient Management Planner (SNMP), the Missouri Phosphorus Index and the Animal Feeding Operation Site Evaluation Tool. *Topic: Litter vs. Commercial Fertilizer*

Jodie Pennington, Small Ruminant Specialist, Newton County Extension Center, Lincoln University and works in partnership with the University of Missouri Extension - Jodie Pennington joined the Newton County Extension Center in December, 2009, as a small ruminant specialist where he works primarily in the southwest region of the state. He is employed by Lincoln University and works in partnership with the University of Missouri Extension in areas of goat and sheep management, production, and marketing. Although his primary audience is producers of sheep and goats who have small acreage and limited resources, he works with all audiences. He has over 30 years of exoerience with sheep and goats. As part of the mission of Lincoln University, minorities of Hispanic or Hmong origin and native Americans with sheep and goats are targeted to better meet the needs of the under-served and under-represented. *Topic: Grazing Systems for Small Ruminants*

Tim Schnakenberg, University of Missouri Extension Agronomy Specialist, Stone County, M0-Tim Schnakenberg serves as University of Missouri Extension Agronomy Specialist based in Stone County, Missouri. He has worked for University of Missouri Extension for 19 years with much of his efforts focusing on pasture and hay management, forage fertility and weed and brush control. He conducts several educational events including Livestock and Forage Conferences, Stone County Dairy Day, farm tours and pasture spray demonstrations. He also coordinates the Master Gardeners of the Ozarks based in Stone and Taney Counties. He is a native of Neosho, Missouri. *Topic-Going Beyond the Spray Boom for Grassland Weed Control.*

Allan Trantham, Trantham Farms- Since 1850, 40 acres have been continuously farmed by the Trantham family in Southwest Missouri. Today the family farm consists of 800 owned acres and 200 rented acres. The farm is made up of dairy, beef, and hay production. The dairy consists of 120 Holstein cows, heifers, and steers in addition to the 150 beef stock cows. On any given day you will find four generations feeding calves, milking cows, and performing various chores as the family contributes 100% of the labor.

We strive to raise quality alfalfa hay and are very successful. 200 acres of alfalfa are harvested four times each year. The first cutting in the spring is harvested as high moisture baleage and wrapped with an inline wrapper for the sole purpose of dairy hay. Subsequent cuttings 2, 3, and 4 are dried down and harvested as 4x5, 1000 lb round bales. We save 2500 – 3000 small square bales of the very finest hay to sell to customers with horses and goats. Hay that is damaged by rain or is not dairy quality is fed to the stock cows, heifers, and steers. We also sell any hay not needed to other dairy operations, some as far away as Texas. *Topic: How to Harvest Quality Hay in Southwest Missouri*

Manure Management in Ultra High Stock Density (UHSD) Grazing Systems Improve Soil Health

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Abstract: Ultra High Stock Density (UHSD) grazing systems is the human application of ecological principles that mimic natural grazing patterns of herbivores. By aggregating and frequently moving large herds of herbivores, plants have a longer time to recover from grazing. Mature plants in UHSD grazing systems increase root/plant biomass, root exudates, extract more water/nutrients, and enhance the nitrogen formation through root decomposition. Higher stock densities improve manure and urine distribution which is important for increasing nutrients and food for soil organisms. Manures metabolized by diverse population of soil organisms synthesize special biotic substances that improve the physical, chemical and biological properties of soils.

Keywords: Manure, ultra high stock density grazing systems, soil health, soil organisms, nutrient cycling,

Healthy soils cycle nutrients efficiently

A couple years ago nitrogen fertilizer peaked at 1000 dollars a ton in some areas of the country. The sticker shock caused many landowners to pause and think about alternatives and question their own farming systems. The production of nutrients--especial nitrogen--accounts for the great majority of indirect energy use in agriculture. Nearly one-third of all the energy used in modern agriculture is consumed in the production of nitrogen (Pimentel 1980).

The high cost of inputs is providing the perfect seedbed of change. Producers throughout the country are taking root to a new way of thinking. This type of thinking was seeded decades ago from agriculturists that believed that nature is the "supreme farmer" and that the best way to deal with natural systems is to mimic it, rather than to force it! This type of holistic thinking understands that soils in natural ecosystems cycle their own nutrients. Soils were cycling nutrients before man came on the scene. Nature has no fertilizer truck feeding nutrients to the forest or native grass lands. Healthy functioning soils provide their own nutrients when the four ecosystem processes are in balance and functioning: energy flow, nutrient cycle, succession-community dynamics, and the water cycle.

In this paper, the four ecosystem process will be discussed briefly. The major focus of this paper will be on how manure is management in (UHSD) Ultra High Stock Density grazing systems also known as "Mob grazing" and how manure improves nutrient cycling (ecosystem process)- which improves soil health.

Energy flow, water cycle, succession, and the nutrient cycle produce nothing on bare ground

Humans interface with all the interconnected four ecosystem processes at the soil ecosystem level. Another way of looking at it, all major land uses: cropping, grazing, forestry, and wildlife all have one thing common…soil. The soil is a living, complex, and dynamic system that is interconnected with other biological systems and the ecosystem processes. Understanding these ecosystem processes will show how important manure is in agroecosystems.

Energy flow

Solar energy powers all ecosystems and the soil ecosystem is no different. Plants are like solar panels that capture solar energy and convert into potential energy, which is stored in chemical bonds of organic molecules (sugars), or biomass. This process is called photosynthesis. This potential energy is harvested by soil organisms and herbivores to do work (e.g., grow, move, and reproduce). Herbivores convert unusable carbon to make protein for humans. As a by-produce they also produce manure that contributes to the other ecosystem processes. Keeping the soil covered with plants increases the ability of the ecosystem to capture solar energy and make it available to the soil ecosystem. Overgrazing can create bare soils which limit the capture and flow of energy. Currently, most cropping systems capture less

than 1 percent of the solar energy reaching the solar surface. Well managed grazing systems can capture 2 to 3 percent of the available solar energy (Pimentel 1980). Bare soil captures 0 percent solar energy.

Water cycle

Most everyone knows that water cycles between the earth and the sky. This cycle is driven by the sun. This is the "water cycle". Nutrients are carried through ecosystems as water passes through plants, animals, soil, and the community before going back into the sky. Water that runs off bare soil has limited opportunity to contribute to life processes.

Signs of a poorly managed water cycle:

- Bare ground that allows water to evaporate and runoff quickly.
- A crust covering the soil. This crust may become very hard and cemented by algae. This prevents water from soaking into the ground resulting in more run off. It also impedes seeds from starting, so there fewer plants to catch the rain and use it.
- Limited surface/ below surface carbon (energy source) from: manure, plant residue, decomposing plant roots, and other decomposing organic matter for soil organisms which help build water stable aggregates for improving water infiltration in soils.
- Changing plant communities- dry tolerant species increase
- Falling water tables, loss of springs and flowing streams.
- Increased short duration flooding downstream.

To manage the water cycle to increase the productivity of ecosystems the soil should be covered with plants, manure, and litter. We have little control over the distribution of rainfall, but we can improve our effectiveness in capturing the rain.

Succession-Community Dynamics

Succession is the process of development that happens in a living community as plants and animals mature and reach their potential. Humans can play a large role the progress of succession. Community Dynamics is a term used to describe how organisms interact with each other in an ecosystem.

Succession does not always result in more complex and productive community. Human interference can hinder progressive succession resulting in environments dominated by annuals and where plant and animal diversity is limited. These conditions are not resilient to ecological stress. Over grazing can create this type of environment. On the other hand a community at a high level of succession will have different kinds of plants and animals, even though none dominates. Biodiversity will be high and productivity is easier to sustain.

Manure increases biodiversity

In grazing systems, once the moist, caloric, nutritive, and microbial inculcated dung hits the soil, a wide myriad of organisms began to feast on this food source. The above soil surface organisms like beetles and flies not only feed on the dung; the dung also provides a habitat for their larvae (Godfrey 1940).

The lower organisms (fungi, bacteria, protozoa, earthworms) also will also join the coordinated effort of transforming this manure into food and energy for the ecosystem. Fungi, bacteria, and earthworms carrying out their metabolic functions will synthesize biotic byproducts that will formulate aggregates for building soil structure and contribute to nutrient cycling. The liberation of life-associated elements, notably carbon and nitrogen will feed plants and other organisms.

Where over grazing has pushed succession back, but grazing can be a management tool to improve the water and nutrient cycles and to encourage biodiversity.

Nutrient cycle

The nutrient cycle is the movement of all nutrients that living things need from the soil and air as they grow. These nutrients are and given back to the ecosystem when plants and animals die. Green plants take nutrients in through their leaves and roots. Animals may eat the plants, but in the end they go back to enrich the soil as manure, urine, or other decomposed matter. The effectiveness of the nutrient cycle is impaired if any of the ecosystem processes are blocked at any point; nutrients are lost from the cycle.

Signs of week nutrient cycle:

- Bare ground with little organic matter so that erosion and leaching carry off nutrients.
- Limited plant roots to sequester nutrients and water. Decomposing roots also become nutrients.
- Plant litter and manure of animals dries out and stays on the surface without decomposing and building the soil.

The remedies in slow fragile (dry) environments are to cover the soil, manage manure distribution, increase manure concentration and return old vegetation and manure back into the soil with the trampling of hooves of heavy concentrated animals.

This type of animal impact will incorporate plant material back into the soil and increase the decomposition process. When large herds of herbivores increase the manure and urine concentration they increase the number of soil organisms that facilitate the nutrient cycle. If organic matter, dead plants, and other material is not incorporated into the soil surface in water limited areas nutrients will be washed away because proper decomposition did not occur.

It is important to mention animals cannot stay on the same area for long period of time or soil compaction will occur.

In fragile dry environments microbes and soil organisms are lacking except during the wet season and in the stomachs of animals. This is just some of the reasons why grazing animals are very important in dry environments. In non-fragile wet environments decomposition can strictly be carried out by soil organisms.

Proper grazing is a "tool" or "action" but not the holistic goal

A healthy functioning soil is a holistic goal. This should be a goal of all landowners because healthy soils save money and energy. The soil ecosystem can only be healthy if all the four pillars (ecosystem processes) of soil are in balance and functioning. When "tools" or "actions" like "proper grazing" become a goal- the holistic picture will be lost and the proper outcome will not be achieved.

A good "tool" for improving soil function is Ultra High Stock Density grazing also known as "Mob grazing". Allan Savory first mentioned "Mob grazing "as a principle of holistic management. Ultra High Stock Density (UHSD) grazing systems, in essence, is the human application of ecological principles that mimic natural grazing patterns of herbivores. Savory considers ultra high stock density to be around 300,000 lbs of beef or more per acre at a given time. Most landowners that do (UHSD) range in stock densities from 250, 000 lbs/acre to 500,000 lbs/acre. The picture below (Figure 1) shows an example of mob grazing.

Figure 1: (UHSD) or Mob grazing

Picture provided by Doug Peterson

Benefits of (UHSD) Ultra High Stock Density grazing systems

Landowners are pushing the innovative edge with (UHSD) Ultra High Stock Density. UHSD (aka Mob grazing) grazing mimics the natural grass harvesting patterns of herbivores throughout the world. This type of grazing harness the soil-building and carbon/ nutrient cycling principles that creates fertility in the perennial grasslands of the world. This type of grazing system improves soil health by:

1) **Increasing organic matter**: In UHSD grazing systems herbivores graze plants when they reach phonotypical maturity. Most grazing systems harvest plants at a younger age. Young plants do not form the tonnage or miles of root mass like mature plants. In UHSD grazing systems, mature plants will increase the volume of mulched plant material incorporated into the soil surface done by the trampling hove action of large herbivores.

   How UHSD grazing systems build organic matter:

   a) Larger plants equate to a larger root mass. A larger root mass- increased soil microbial biomass.
   b) Increased soil microbial biomass- more decomposition of organic materials, and cycling of nutrients that will formulate more organic matter.
   c) Increased number of animals in given area-more concentration and distribution of urine and manure to enhance nutrient cycling for increasing organic matter.
   d) Increased decomposition by soil organisms- more biotic cementing agents

that build water stable aggregates which increases water infiltration- vital for nutrient cycling.

2) **Invasive weeds decrease:** Grazing animals become less selective when they have less time and opportunity to be picky what plant to eat. Mobbing causes animals to lose their individuality and instinctively become more aggressive-diminishing selective grazing habits. This results in an even mowing and a tremendous reduction in normally ungrazed plants. This pushes succession of the good species to get a head. Thistles, dewberries, iron weed, broom sedge and other weed species are diminished. Under this learned primal instinct no weed is left ungrazed.

3) **Animals fill up faster:** animals in UHSD grazing systems start to ruminate sooner because the various mature grass and weed plants consumed. The mature plants will have less protein but more starch which will stimulate the fermenting process in the ruminant.

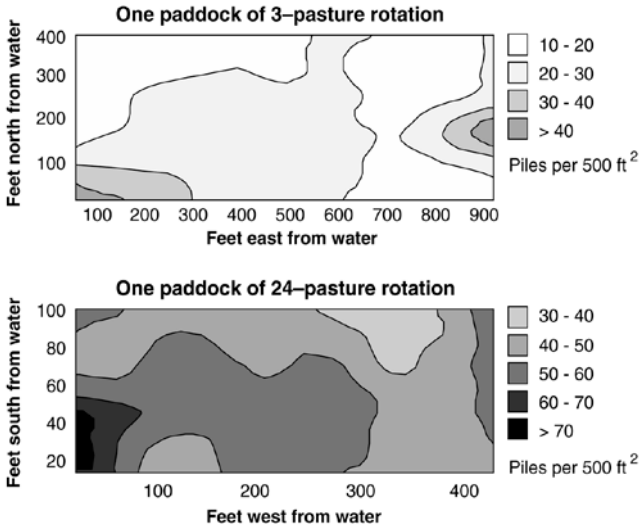
4) **Mulching is increased:** high hoof impact in UHSD systems will incorporate more carbon into the soil system by pressing dry matter on the surface left by desiccating plants. This intimate contact of dry matter with soil organisms increases nutrient cycling.

Manure management in (UHSD) Ultra High Stock Density grazing systems

Increased distribution of manure and urine

Figure 2 shows that manure distribution improves when intensity and frequency is increased in grazing systems. In the 3-paddock system (analogous to continuously grazed pastures) very few manure piles are deposited in the main paddock area. The 24-pasture rotation (intensive grazed pasture) concentration manure increases. There is a concentration of manure near shade and water; the field where manure piles are most densely concentrated (shade, east end; water, southwest corner

Figure 2. Manure Distribution



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In (Table.1) the data shows when grazing intensity increases the number and distribution of manure piles increases throughout pasture systems.

Table 1. The effect of grazing intensity on manure distribution in pastures

Rotation frequency	Years to get 1 pile/square yard
Continuous	27
14-day	8
4-day	4-5
2-day	2

Benefits of manure

It is generally assumed that the “active principles” of composts, manure and humus are the mineral elements of nutrition. Although mineral elements (inorganic chemistry) are important, it is the “biology” which dominates and transforms soils. Research in the last 70 years indicates that microbes create special compounds of an organic character which makes plant and soils healthy. They also make inorganic nutrients more available. The organic substances of manure and the biologically active metabolites of microbes form vitamins, auxins, enzymes, nutrients, and other biotic substances and make them more available for plant growth. These organic substances also bind soil particles-creating aggregates. Manure is not just pre-digested organic materials comingled with urine, water, and other complex organic

compounds sprinkled with bacteria. In essence manure "cultivates" the growth of the complex soil food web. When all the soil organisms carryout their metabolic functions they create beneficial substances that maintain soil function.

Manure is much more than NPK……

It is well known that manure and compost are sources of NPK. It is assumed that these elements in manure are the primary nutrients which increase plant production and health. However, Dr. Krasil'nikov (1961) and other scientists have demonstrated that the organic nutrients in manure are just as important as the inorganic nutrients (NPK). According to their observations the active principles of humus and composts are not the mineral nutrients present in them but the organic substances and the biologically active metabolites of microbes.

How much manure is needed to benefit soil quality?

Determining the proper amount of manure needed to build soil quality is not a black and white answer because the soil is a living dynamic ecosystem. It is the myriad of soil organisms that build soil quality.

Soil organisms are impacted by the following factors: soil temperature, soil moisture, soil texture, physical disturbance, timing, quality and quantity of manure. When all the dynamic factors are considered for building soil quality, it becomes difficult to make a generic recommendation on how much manure or compost is need to improve soil health. Several studies indicate that a range of 13 to 20 tons of manure /ac/year is optimal for building (WSA) water stable aggregates in typical farming fields in (wet) non-fragile environments. In (wet) non-fragile pastures environments- less manure is needed-typically needed for building WSA but more for maintenance and cycling of nutrients. In (dry) fragile environments more manure can be utilized. The following lists (1-3) show how these biotic substances improve the physical, chemical, and biological properties of soil.

List 1. How soil organisms utilize manure to produce biotic substances to improve the *physical* properties of soils:

1) **Increase soil organic matter:** Manures and compost increase the numbers of various soil organisms which metabolize and synthesize various organic compounds into humic substances, a component of organic matter.

2) **Builds soil structure**: Soil organisms metabolize manures and composts to formulate organic compounds (i.e., aliphatic and aromatic compounds) that can bind soil particles and create organo-mineral complexes for flocculating aggregates. These relationships are dependent on soil texture and organic C content. Fungal hyphae also increase soil aggregation.

3) **Reduce bulk density**: Organic glues are formulated when soil organisms metabolize organic substances (i.e., manure and compost). These biological glues provide the proper construct for keeping intact the proper distribution and geometry of pore space for lowering the density of soils

4) **Increase hydraulic conductivity (K):** Biological glues increase and maintain pore space by creating water stable aggregates which hold intact the distribution and the geometry of the soil pores, so that water flows with ease through the pore spaces.

5) **Reduce surface crusting:** Soil organisms metabolize manures or composts to formulate organic glues which will reduce the dispersal of clay and small particles that can clog soil pores. This thin fine layer of structure less material is called surface seal or crust.

6) **Increase water holding capacity:** Organic glues formulate aggregates which increase infiltration and maintain larger pore spaces for more water holding capacity. Also, increased organic matter holds 4 to 5 more water on a mass basis than silicate clay.

7) Increase infiltration: Large (macro) and small (micro) pores are increased and maintained by biological glues formulated by soil organisms. These cementing agents (glues) not only hold pores in place, but earthworms and other creatures create bio pores which increase infiltration

List 2. How soil organisms utilize manure to produce biotic substances to improve the *chemical* properties of soils:

1) **Increase buffering capacity:** Buffering capacity is determined by the presence of clay, humus, and other colloidal materials. Manure and compost build organic matter (OM). Derivatives of OM are humus and other organic substances:

2) **Increase biogeochemical nutrient cycling**: Manure and compost provide food and habitat which increase soil organism populations. Soil organisms facilitate in the decomposition dynamics of soils which increases nutrient availability. Soil moisture, soil temperature, and soil N and C composition impact biogeochemical nutrient cycling.

3) **Increase chemical activity:** Soil organisms metabolize manures/compost which formulate

humic substances: Humic substances are of essential value to:

- Activate disintegration of soil rock-releasing additional supplies of plant nutrients.
- Increase phosphorus conversion for plant availability- reduce tie-up of P2O5
- Neutralization of soil chemical substances that may cause plant toxicity.
- Store nutrients and energy-When broken down high molecular organic materials provide 5,000 calories per gram of energy for use by plants until further biodegradation takes place

4) Increase Cation Exchange Capacity (CEC): Soil organisms metabolize manures/compost that coat soil particles with humified compounds and glues which form aggregates. These aggregates enlarge surface-active materials which increase the interchange between cations in solution and cations on the surface of the aggregate. In long term studies manure applied to sandy and other textured soils can increase cation exchange capacity (CEC).

5) Increase soil pH in acid soils: Carbonates and bicarbonates in manure can contribute compounds to adjust pH. Also manure has organic acids with carboxyl and phenolic hydroxyl groups which buffer soil acidity and increase the pH of acid soils. This depends on the source of manure and soil characteristics

6) Decrease soil pH in calcareous soils: Organic acids in manure and composts can lower pH in calcareous soils (pH 7.8) after long periods of time (11 years) when applied 3x times the recommended rate; can lower pH 0.3 to 0.7 units. This depends on the source of manure and soil characteristics.

List 3. How soil organisms utilize manure to produce biotic substances to improve the *biological* properties of soils:

1) **Increase soil microbial biomass and diversity:** Manure and compost provide the food and habitat for soil organisms to increase their populations: bacteria, fungi, actinobacteria, earthworms, and myriad of other soil organisms.
2) **Increase enzymatic activity:** Manure and compost applications to the soil increase invertase, catalase, and urease. These enzymes are essential for the hydrolysis of various chemical compounds in the soil. It is assumed that extracellular enzymes are important for the transformation organic compounds and, in particular, in the synthesis of humus compounds
3) **Reduce soil toxicosis:** Toxicosis is a phenomenon which suppresses plant growth and development of higher plants. This is caused by an accumulation of special biological toxic substances created by plants and microbes as a result of poor agrotechniques like monocultures. Soil toxicosis expresses itself in relation to higher plants, bacteria, fungi, actinobacteria, and azotobacter. Manure, compost, and diverse crop rotations help reduce soil toxicosis. Vitamin content of plants varies in accordance with soil, climatic conditions, season, age of plants, and etc.
4) **Improves nutrient uptake for plants:** Manure and compost provide humic substances that stimulate the phenol-oxidase system, increase plant metabolism, and promote plant respiration. They also stimulate fungal growth. Fungus, such as Arbuscular Mycorrhizae increase P, Zn, and Cu uptake. Increased macro and micro organisms feeding /dying make nitrogen and other nutrients available to plants.

Some basic planning considerations for (UHSD) Ultra High Stock Density grazing systems:

Step I – Plan: make a map of the "Whole"

Make a plan map. It should show details like water points, houses, and landmarks. It should be close to real scale. Areas that are big should be big. Areas that are small should be small.

Printed maps and aerial photographs are helpful if the scale is large. You can cover them with plastic and draw on the plastic with felt pens. It is best to plan with special felt pens that you can erase.

The map should show everything that is important for management

Step 2 - Decide the grazing areas

Divide the land into grazing areas and mark them on the map. Make as many as you can, but try to have at least ten. For each grazing area think about:

- Water
- How animals will go there and come back
- Where animals will stay at night Care (Young animals, milking, breeding, etc.)
- Special problems (nearby crops, land arguments, flooding, etc.)
- Mark the boundaries.

Give each area a name or number so you can discuss it with others. This step will need a great deal of thought

and discussion. There are literally hundreds of possibilities for any situation.

Step 3 - Decide recovery periods

A plant needs time to grow back after an animal bites it. In fragile areas (dry) where the rain is often poor it may need 150 days or more. In many non-fragile (wet) areas and when rainfall is good, it may need only 20 - 40 days. In irrigated pastures maybe 15 - 30. A drought of course changes everything.

This aide is based on a recovery time of 90 days. That is safe for most places, but is may not be optimal for some situations. During times when plants are growing very fast (more than 2 cm a day that you actually measure) you may shorten the recovery time to as little as 30 days.

If you have ten grazing areas, and your herd stays 10 days in each one, then all will have 90 days recovery time, and the whole cycle takes 100 days. If you have more than 10 grazing areas, you get even more recovery time and shorter grazing times. For your first plan, it is usually safe to use a 100-day cycle, but if you want more than a 90 day recovery, use a longer cycle.

Step 4 - Decide grazing times

Collect data and place markers for the days in the cycle (100 for a 100-day cycle) and distribute them among the grazing areas on the map. Give more to the areas that are richer or bigger. Give less to poorer areas. If one area produces twice as much forage than another area it will get twice as many days (marks) of grazing.

Step 5 - Plan the grazing

You need your map and a "time line". The time line can be drawn on paper or with a computer, or on a chalk board. It is a line marked off in days like a tape measure.

Mark on the line the days that the herd will spend in each grazing area. If you use paper do not use permanent pens or markers, because there will be a *lot* of discussion about this and you will make many changes.

Check all the recovery periods on the time line. Are they all close to 90 days (depends in your area)? Probably some areas are grazed once and others twice. Mark on paper and put it on a calendar or use computer program.

Step 6 - Following the plan

Dividing up the grazing times among several grazing areas will help stop overgrazing, but skillful grazers who move their herd day by day (or even hour by hour) through each area will help the land very much more. Always be flexible and aware of reality. No plan will be perfect. At the beginning, many places may continue to degrade - water points and driveways for example. While you look for solutions, you can accept this if most of the land is improving toward your holistic goal. However, you must act to change the plan whenever your observations and common sense justify it.

Step 7 - The number of animals

Except in time of extreme drought, very few animals starve during the growing season, so the number of animals is usually not a problem then. With a good grazing plan you can feed many more animals than you did before, and you are now using them as a tool to reach your holistic goal. With more animals you can create more animal impact

Step 8 - Decide how many days of forage each area must give

You now know how many days each area *must* feed your animals, so they will live until growth starts again. You don't know yet if the forage is really there, but you will soon find out. These planning steps come from the booklet - Grassroot Restoration: Holistic Management written by Sam Bingham.

NRCS provides assistance

If you need assistance for planning, installation, and cost share assistance for implementing conservation practices on your land. Contact your local NRCS office. Table 5 shows a list of some of the conservation practices available for cost share, different parts of the country, the list may vary.

Table 5. Typical list NRCS conservation practices for prescribed grazing systems

NRCS Conservation Practices	Standard Number
Prescribed Grazing (ac)	528
Fence (ft)	382
Pond (no)	378
Brush Management (ac)	314
Animal Trails and Walkways (ft)	575
Forage Harvest Management (ac)	511
Grazing Land Mechanical Treatment (ac)	548
Heavy Use Area Protection (ac)	561
Pipeline (ft)	516
Pasture & Hay Planting (ac)	512
Range Planting (ac)	550
Silvopasture Establishment (ac)	381
Spring Development (no)	574
Stream Crossing (no)	578
Use Exclusion (ac)	472
Watering Facility (no)	614
Water Well (no)	642

Points to Remember

- Water and nutrient cycles, energy flow, and succession produce nothing on bare ground.

- In *non-fragile (wet)* areas where the air is always damp and rain falls in all seasons, plants will quickly cover bare ground no matter what you do. Nothing can stop them.

- In *fragile (dry)* areas where the year is divided into wet and dry seasons, livestock or wild grazing animals are necessary to keep the grass healthy and to cover the soil with litter.

- In *fragile (dry)* areas, bare ground is caused by repeated fire, overgrazing, but most of all **rest**, both partial and total.

- Herbivores and their manure are necessary and interconnected to ecosystem processes.

- Overgrazing is not caused by too many animals, but by **any** animal that spends so much **time** in one place that it can graze the same plants again and again **or** if any animals can return to the same place before the plants have recovered

- Many plants may suffer from over-rest even when grazing animals are present if they stay widely scattered, calm, and never move quickly in a tight herd.

In conclusion:

Grazing is a natural occurrence, but overgrazing is a disturbance. It is important to note that herbivores and grass are designed to be together. Many in the ecology community use the word “disturbance” to describe grazing. This type of terminology gives natural resource managers and landowners a negative perception of grazing.

Manure piles generated by grazing animals are an important contribution to the nutrient and energy cycling that occurs in grazing ecosystems. Grazing animals can be managed to control the location, distribution, and effectiveness of manure piles.

Herbivores harvest the sun energy and their manures contribute to the nutrient cycle, it enhances succession-community dynamics, and builds soil to complete the water cycle. The closer we mimic nature grazing patterns and apply the ecological principles and grasp the holistic picture. The healthier ours soils, plants, animals, and humans will be.

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Vision for Herd Improvement
Gearld Fry

When you're out in your pastures and walking among your cows, what do you envision? Do you see cows that can give you the greatest return for the grass they consume? Do you see having a bull that is a genetic bank reserve for your future? Does your vision include a positive plan that builds and leaves a legacy of genetics and livestock for your children or those who may possess your livestock after you? Is your livestock operation managed as a business with quality control standards; each generation of animals is better than the generation that produced them?
If any of your answers are no wouldn't you like to begin moving in that direction?

I am reminded of a statement from a friend who had consistently produced herd sire material bulls. He had produced one of the greatest bulls I ever had opportunity to see. I also witness his offspring and their production and performance. On a visit to his farm I saw the bull's mother who was 14 years of age at that time. She was pregnant and in my friend's cull pen.

I made the remark to him that he must be out of his mind to sell a cow with that genetic potential. I'll never forget what he said next. He said that if the daughters from that cow weren't at some point better then her then he better change his breeding and management program.
That was a monumental remark to me. Those words opened my mind in ways I had never considered or thought necessary before.

What I realized is that I am working in the business I have chosen and I am **producing food for human consumption**! I am responsible for the quality of that food, or lack of it, and its consequences to the consumer. *It was time for me to pay attention to the particulars.*

It makes no difference whether one is a commercial producer or raising and working with registered livestock, we all need a vision to inspire us and give us direction. The direction I am talking about is how to make improvements in our herds so that they are the most efficient on grass and produce quality food. Unfortunately many need a heart transplant; certainly a change in mindset before they can get started and that can be the most difficult step. But the industry can't continue with the same commodity protocols and expect to make a difference for sustainability or food quality.

After hearing what my friend said that day I was determined to gain a higher level of knowledge. I became hungry to understand things like I never had before. It also became my desire to build a knowledge base that I could pass on to others and help them develop a vision for a breeding plan and management program – a worthy foundation to build upon. The knowledge I seek and continue to find creates positive and profitable livestock genetics that when managed correctly produce milk, meat, and the healthy fats that demand the respect of the American consumer. I believe this to be a Godly agriculture act. We can be blessed by change and being different. It is my observation that folks can't stay the same and survive.

The following is a short summary of my many years of work and research. It is meant to help guide you if it your desire to work with livestock as grass harvesters that in turn provide a way of life and livelihood for you and your family.

Always remember we are in the business of producing **fine food** and we must do that responsibly. Training your children is the second most important responsibility of this endeavor; however you must be trained first.

I was introduced to Tom Lasiter in 1956, Dr Jan Bonsma in 1978, Buck Chastain in 1988, Harlan Doeschot in 1995. I got to know Teddy Gentry beginning in 1999, Ken McDowall in 2003, and Billy Don Finnon in 2006. These and many other successful stockmen have provided priceless information about livestock management, selection and breeding. These practices are still as valid today as when I met each man. Each of these men has left a deep-seated artisan desire in my heart and spirit to practice truth and reality in my cattle operation and to teach this truth and reality to other cattle producers. All of these men were students of truths and reality before they became teachers and mentors. Each had concerns about the quality of product they produced for human food.

What is most intriguing is how each cattleman used animal selection, breeding and management practices that were unique and relative to their own environments yet in reality turned out to be quite similar.

I continued consulting with hundreds of livestock producers around the world and discovered the same problematic conditions existed everywhere. This was reason enough for me to begin formulating a selection, breeding and management program that could be followed easily with the cows a person already owned without spending a lot money, a program that would be profitable. It does require using a herd bull with genetic density on the paternal side (natural service or artificial insemination). Either way can work when the program is followed and animals are managed as presented below.

The Fry Herd Improvement Program focuses on 5 animal traits. These traits or characteristics are achieved through the process of knowing how and what to select for, having a solid breeding plan, and managing the herd for full genetic expression and productivity. It is not possible to cover every detail. Everyone's operation is a little different with different management strategies and goals.

#1 Herd Purity The goal to be shooting for is to have your herd sire and all replacement heifers come from within your herd. This gives you a paternally dominated gene pool. Your bull becomes the genetic reserve bank for your cattle operation.

I can't stress enough the role of the bull here. Any bull worthy of herd sire status is to have the genetic density to control the outcome of his progeny. He must be of strong paternal origin or genetically strong enough to build a gene pool using the top (5%) cows in your herd. He must also be stronger genetically than the best cow you own whether you are commercial or a registered breeder. With this kind of bull your heifers turn out better than their mothers and are potential herd bull producers. Using this kind of bull will put you ahead 3-4 generations in your herd improvement program.

Herd purity is about the cows on your farm - not a national breed. It could be a recognized or registered breed that you currently have, but you are to practice herd purity using the genetics on your farm. **Do not** bring in another outside bull after you begin the program. Any bull you produce from the best 5% of your herd (cows) is better for your herd improvement program than any bull you will purchase. Working towards herd purity means eliminating the effects heterosis has on your herd. Once you've created your paternal gene pool, bringing in any outside paternal

genetics will only set you back; you loose the consistency in performance you worked to establish.

Continue the work in your program and look to the top 5% of your females for your herd replacements and future herd bulls. Be vigilant about selecting females who have the correct body type and are high butterfat producers. Linear measuring your cattle is a valuable tool that teaches you how to evaluate them and assess their quality. It makes for positive steps in the selection process.

#2 Utilization of Grass To me this means the ability of the animal to make its total living from the grass, green or stored that is produced in your environment and return to you a reasonable profit. The animal that can efficiently utilize your grass will have shoulders that are as wide as the length of its rump. (See the Linear Measuring for details).

You're looking at an animal that has a grass utilization efficiency rate of 65-70% as apposed to the average, which is 50%. Cows with less than a 65% return loose body condition while lactating and are slow to rebreed. Steers that are narrow in the shoulders are slow to finish. Calving intervals get extended because of late maturity.

Loss of body condition, a higher susceptibility to sickness and disease, death in baby calves are common issues with an under developed gland system. Narrow shoulders mean a narrow heart girth, which in turn create a restriction for heart, lung and gland development. Folks pay attention to those shoulders.

As a side not, the highest butterfat production always comes from grasses that are highest in digestible fiber. Cows with 4% butterfat milk production seldom ever have sickness in their calves and this nutritional component is foundational in building herd replacements that can prosper in your environment, on your grass. Without high butterfat none of the 5 traits can occur consistently.
Butterfat, fine textured, tender meat and intra-muscular fat (marbling) are a genetic characteristics you can and must select for and no amount of feed will create it; quality meat, milk and fats always come in the same genetic package.

#3 Quality of Product – meat and milk both having high levels of EFAs (essential fatty acids or good fats) Creating females that have the genetic ability to produce gourmet meat and milk is only possible when you have mother cows that give 4% milk fat or higher. It is impossible to get fine eating products from cows that produce low fat milk (3% or less). Only animals (male and female) who possess the genetic ability for higher butterfat production are the ones with white tablecloth fine eating potential. These are the only animals with true and properly distributed intra-muscular fat, a precursor for flavor and juiciness. A cow/bull's intra-muscular fat potential is directly linked to his/her genetic potential for butterfat production.

#4 High Muscle Mass Only the heavy muscle massed animals can give you a profitable return at the market place for the grass they consume. I am talking about a carcass with a 65% or greater yield of saleable product. The more volume of meat per carcass the cheaper you can grow that animal and the greater return from your grass. It again goes back to the body type. These heavy muscled animals, meaning the shoulder width always matches the rump length or larger, are the progeny of high butterfat genetics. In all these correctly built animals the theoretic cavity (space between the shoulders) is in balance with the body's demands. I call them rugged, as they are very adaptable, trouble free and good producers.

The type and quality of the bull and cows you start with using this 5 trait program will determine how generations of calves and selecting is requires to reach your goals. All this is to be done with the best 5% of the cows in your herd. Using average cows will take 4-6 generations using a good bull with desired traits and characteristics to bring that desired change.

#5 Reproduction Reproduction is not last because it is the least important. It is also of the highest priority. No single trait is the most important. I consider all 5 traits and their particular characteristics when making selections and breeding decisions with each generation. Reproduction has more to do with selecting a quality sire. His semen has to meet the highest quality standards for volume, % live sperm, low % of abnorms, and good forward motion. He has to have high testosterone production, which gives him the desire to mate frequently (fecundity). The cow is to also possess a high level of fecundity. You're looking at a bull with a near perfect set of testicles and acceptable scrotal circumference. That correlates with reproductive performance in his daughters and sons.
One cannot create the 5 traits without the reproductive qualities yet you won't realize the reproductive qualities without the other 4 traits and specific herd management protocols. Quality, performance and repeatability come in one package all together. We must learn to select for all these traits and refuse single trait selection.

Building a sustainable all grass-fed cowherd is about selecting for a body type and then implementing specific management practices to optimize their performance. The genetic component to this relates to carcass quality, high butterfat milk productions and then building towards herd purity.

The program begins with selecting foundation cows that make milk with 4% butterfat or higher. Cows are to be bred in late August or early September so they calve in late May or June, the same time Mother Nature gives rise to her new generation of deer, elk, and other undulants. This also gives the cow the opportunity of being on lush green grass for a few weeks and building quality germ plasm for the next conception.

The next important management practice that I can't stress enough is letting your calves nurse for a full 10 months. Unless the mother cow weans earlier, less then 10 months sets calves up to have structural weaknesses and mature later. A later maturing animal is tall and framey and poor utilizers of grass. Heifers that are weaned early are much slower to rebreed for their second calf.

It's perfectly fine to allow a cow to wean the calf herself. A pregnant cow will do this at least 45 days prior to her next due date and most often 60 days prior. Watch for the occasional pair that don't stop milking/nursing and deal with them accordingly.

It is also healthy to leave the female calves with their mothers, sisters and aunts. There are many benefits to their family unit behaviors. You will want to remove the yearling heifers during the time period when the bulls are with the cowherd and then put them back when you separate the bulls out.

While it can be inevitable that cows are sometimes relocated, there are unintended consequences. When a bovine consumes forages at a location that they've never been to before that pasture contains a different variety of vegetation with different minerals and plant nutrients and the adjustment they go through can cause temporary havoc. The pregnant cows' calves suffer the most. They were conceived on different grass and the milk created from the grass on the new

pastures is a change that does not mix well for new calves. I recommend you never put any of these calves in a pasture they and their mothers have never grazed before.

If you need to move animals to a new pasture, early winter (cool season) works best. If you must move to new pastures the newly weaned heifers will have a year to adjust before breeding as two years olds. It can take up to 3-4 years for a cow or bull to fully adept to a new environment.

There is information on my website and the book Herd Bull Fertility is another resource to find information needed to guide your selection for a herd sire out of one of the cows in the top 5% of your cowherd. Remember we're talking about an animal that will make improvements in each generation he produces.

I realize these methods and practices are quite different than the customary management practices in use today. From all my studies and travels around the world the successful stockmen I have found use these similar methods. Unknown to most, this kind of breeding plan is the same described throughout the Old Testament for their livestock. The food produced in those days kept the people healthy, able to endure hardship and I believe our children and we need that same level of nourishment.

It is impossible for me to cover all the selection and management points in such a short space as this. Some of the material will become self evident, easy and even fun however your new level of knowledge will carry you to places you have never been and I suspect you will want to share this knowledge with your neighbors and friends.

The second most important responsibility in producing food is to train your sons and daughters about the reality of truth and the consequences of our choices. Then they can pass on these truths to their children and your grandchildren will be the recipients of a very valuable legacy.

You have participated in a Godly Agriculture act that will continue on through many generations. What could be more honorable than a form of a truth that follows our Creator's example and enhances the well being of our bodies (His temples).

God Bless as you farm (produce food) and train your sons and daughters how to live and have a level of intelligence that only wholesome food can provide and to be independent from a slave system that only teaches science and control.

Error seems to be propagated with the velocity of light. Every obstacle disappears before it and everywhere it is welcome. Truth on the contrary, is usually received with indifference, and often with doubt, mistrust or suspicion. Happy are the ones who have followed a different standard with better ideas and have succeeded for the good of self, family and mankind. ***Francis Guenon***

If you need help please contact me. I can help or put you in contact with a person in your general area. I can be reached at 501 454 3252, or gearld.fry@gmail.com Information is also available on my web site at bovineengineering.com

Grazing Systems for Small Ruminants

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Introduction

Small farms are becoming more popular as residents migrate to the suburbs or close-by farms. This movement is further accelerated by the aging population, many of whom had a rural up-bringing and desire to supplement their income with small farming operations involving sheep and goats or simply have hobby farms to occupy the time. Many owners of small farms have limited agricultural backgrounds and need training on basic agricultural practices for livestock production.

Small ruminants such as sheep and goats work well on both large and small farms but are especially adapted to small farms as they require limited facilities and are safer to handle than larger animals. Additionally, they can utilize forage and other vegetation on the farm that is otherwise a negative resource as it has to be mowed and maintained.

Feed usually accounts for 50-65% of costs associated with livestock production, including small ruminants. Generally, forages are the least expensive source of nutrients for small ruminants and pasture is the least expensive method of harvesting forages. Presently, efficient utilization of forages is especially critical as grain and related by-product prices are near all-time highs. The goal of all grazing systems is to provide adequate nutrients to the sheep and/or goats with minimal or no grain supplementation. In general, younger animals and lactating females will need the highest levels of nutrition while dry animals will need the least.

The selection of a “best” system for forage utilization will depend on the goals of operation and the land and other resources available. Many small farms have limited equipment and cannot justify planting and harvesting costs for traditional forages. With grazing, small ruminants can utilize forages with either multi-species grazing or by themselves. Continuous (or conventional) grazing systems are more frequent than either multi-species or management intensive grazing (MIG, sometimes called rotational grazing) systems. The breed of sheep or goat on a farm also will depend on the goals of the farm. Meat breeds of goat are most popular and hair sheep are increasing in popularity in southwest Missouri as the breeds of wool sheep decrease in numbers.

Importance of Availability of High Quality Forages or Browse

In all grazing systems, it is important to have forages and browse that are high in nutrients so that the sheep and goats can obtain the nutrients needed for maintenance, growth, reproduction, and lactation. There is a lot of variation in forage quality, but legumes (clover, alfalfa, etc,) are usually superior to grasses (fescue, Bermuda, wheat, ryegrass, etc.) in that they are lower in fiber, more digestible, and higher in energy than grasses. For both legumes and grasses, the vegetative or growing stage has greater nutrients than the mature stage of growth. It is surprising to some that leaves of browse (bushes, trees, vines, shrubs, etc,) can be of high nutritive value.

The availability of forage or browse is also important as small ruminants tend to decrease intake when forage availability is below 1000 to 1200 lbs of dry matter per acre.

Multi-species Grazing

Multi-species grazing is the practice of using two or more species of livestock together or separately on the same land in a specific growing season. Multi-species grazing is most often utilized on larger farming operations but can be utilized on small farms, usually of 10 or more acres. With an understanding of the different grazing behaviors of each species, various combinations of animals can be used to more efficiently utilize the forages in a pasture. Different species of livestock prefer different forages and graze them to different heights.

Sheep and goats eat forbs (brushy plants with a fleshy stem) and leaves better than cattle or horses (Table 1). Many weeds in a grass pasture are forbs. Cattle and horses tend to graze grasses better than small ruminants such as sheep and goats. Cattle tend to be intermediate grazers. They graze grasses and legumes and bite with their mouth and tongue. Sheep and horses graze closer to the ground than cattle.

Table 1. Dietary preferences for different livestock species (From "Nutrient management in mixed specie pastures for goats", An Peischel, 2005 Nutrition Conference, University of Tennessee, Knoxville).

Species	Grass (%)	Weeds (%)	Browse (%)
--Horse	90	4	6
--Cattle	70	20	10
--Sheep	60	30	10
--Goats	20	20	60

Goats are browsers (Table 1) and prefer to graze with their heads up. Browse is the tender shoots, twigs, and leaves of trees or shrubs that are acceptable for grazing. Goats browse like deer if given the opportunity. They will eat higher growing plants such as forbs and shrubs as well as high-growing grasses. With their mobile upper lip, goats can select individual leaves and strip bark off of woody plants. Their unique lip allows them to eat the parts of a plant that are highly nutritious while leaving behind the less digestible parts such as the thorns and branches of blackberries and multi-flora rose. Both goats and sheep will eat weeds although goats prefer browse more than sheep. Goats are usually better than sheep in clearing brush and undergrowth in a woodlands.

Brush and weed management is the most noticeable benefit that producers see from multi-species grazing with cattle and small ruminants. Although research indicates that multi-species grazing can contribute to more efficient and uniform use of pastures, the results will vary with the type of pasture. Land that includes grasses, forbs, and browse are best utilized with multi-species grazing. Land that is uniformly in grass may best be utilized for cattle or horse production. Multi-species grazing can improve utilization of forages by less than 5% to more than 20%, depending primarily on the type of vegetation on the land and the mix of animals used.

Concerns with multi-species grazing involving cattle and small ruminants are similar to having sheep and goats only. The primary concerns are parasite and predator control and fencing for the goats or sheep to limit movement of the inquisitive animals. Parasite problems actually seem to decrease with multi-species grazing because the small ruminants are grazing further from the ground. Labor also can be an issue since the species may be grazing at different times. In such

cases, additional labor is needed to move the livestock from field-to-field. Depending on the environment, small ruminants may require a more extensive program to control internal parasites than cattle which adds to labor demands.

Some type of predator control program is essential with sheep and goats as they are more susceptible to feral or local dogs and coyotes than cattle. Cattle may serve as a deterrent to the roaming canines but extra precautions are usually needed. Livestock guardian animals are most commonly used to protect the small ruminants from predators. Dogs such as the Great Pyrenees or the Anatolian Shepherd are most used as guardians, but donkeys, mules, mustangs, and llamas are also used. If a guardian animal does not protect the herd, it should be replaced.

Usually more exterior fencing is needed to keep unwanted canines away from small ruminants as well as to keep the small ruminants in the field compared to cattle. Goats require a little more extensive fencing than sheep to keep them confined but even more extensive fencing is required to keep the coyotes out of the field where the sheep and goats are grazing. Reinforcing existing fencing with electric fencing is usually the most economical method. One example is to add three strands of electric fence to an existing 5-strand barbed wire fence. Another method is to add three strands of barbed wire which would work well for an interior fence but this method is less likely to keep predators from going under an exterior fence.

As with all livestock, there may be personality conflicts with mixed species of animals. If this occurs, the least desirable animals involved in the conflict are best culled from the herd.

Another problem with grazing of multiple species is the feeding of minerals. Usually goats and cattle can use the same mineral unless there appears to be a health concern. However, sheep do not tolerate as high a level of copper as do goats and cattle if the animals are being co-mingled.

Multi-species grazing can have additional benefits other than greater pounds of meat per acre. Because gastrointestinal parasites from goats or sheep cannot survive in the stomach of cattle and vice versa, multi-species grazing may decrease internal parasite loads. The decreased level of parasites should result in fewer treatments for worms which could slow resistance of parasites to conventional dewormers, an increasing problem with small ruminants. In a field infected with a high load of larvae from sheep and goat parasites, cattle should be grazed first to pick up the larvae of parasites, and then goats or sheep could graze with less danger of parasite infestation. In other situations, producers may prefer to have small ruminants graze before cattle as most of the larvae of internal parasites are located on plants within 4 inches of the ground.

Briefly, producers with cattle can obtain greater pounds of meat per acre and can reduce weeds and brush in a pasture when adding small ruminants for multi-species grazing. These benefits need to be compared to the additional labor and fencing requirements for the small ruminants as well as the costs of predator control for sheep and/or goats.

Sheep and Goat Grazing Systems

Small ruminants also may be used in continuous and management intensive grazing (MIG) systems. Sheep and goats are most often maintained in the continuous or conventional grazing system. The continuous system has the animals on the land continuously until the available nutrients are consumed. With MIG, the pasture is fenced in small paddocks and animals are rotated often according to the availability of forage. They then are rotated back onto a paddock as soon as the growth rate of the forage allows. MIG systems result in greater production per acre but require more management, labor, and fencing than continuous grazing systems. Other

advantages of rotational grazing are that animals can be examined more easily and frequently as they are moved and the surplus forage can be harvested as hay.

Both continuous and MIG systems can be used with multi-species grazing. In general, sheep are better used in an MIG system than goats as the data are mixed on improved gain per head for goats with intensive grazing. Parasite control is usually a more significant problem with continuous grazing systems and to a lesser extent for MIG systems than with multi-species grazing. It is essential to establish a parasite control program for small ruminants and adhere to it. Goats are more susceptible to worms than sheep, but both species can be severely affected by parasites. Compared with multi-species grazing, predator control also is of greater concern with only sheep and goats since the small ruminants do not have a larger animal as a deterrent to the predators. Foot rot can be a concern with both sheep and goats although sheep appear to have more problems with feet than goats.

One other aspect that must be considered when choosing which type of grazing system to use is the fact that a rotational, intensive grazing systems require much more fencing than the other systems do. Rotational grazing is more labor intensive and often more expensive than traditional continuous grazing. Electric fences that are easy and quick to build have made subdividing pastures easier and more economical. Many producers also use high-tensile electric wire fencing, either permanent or temporary. Electric fences serve as method of predator control because they will keep predatory animals from the small ruminants. The exterior fencing is more extensive than interior fencing since additional strands of wire are needed to keep the predators away from the small ruminants than to keep the sheep and goats in the field. Goats will require more fencing materials than sheep.

Additional research needs to be conducted to determine the efficacy of sheep and goats in utilizing brush and browse in a woodland environment. Further work also in needed to determine which breed of animals is best adapted to eating brush/browse and conventional pastures. All breeds of small ruminants have advantages and disadvantages over other breeds. More data are needed to compare the economic advantages of different breeds of sheep and goats in SW Missouri. Although Boer goats set the standard for muscle among the goat breeds and have received much publicity in recent years, some Boer goats require more management than some other breeds of sheep and goats. Some producers wish to minimize time and management with their small ruminant enterprise. Hair sheep appear to fit this niche of requiring less management than some of the other breeds of sheep and goats. Katahdins, mainly, are becoming more popular in southern Missouri. However, economic data are very limited comparing breeds or species of small ruminants.

Summary

Well-planned grazing systems can help reduce the costs of purchased feeds that are utilized by small ruminants. Forages are available in southern Missouri throughout most of the year and can supply almost all of the nutritional needs of small ruminants, with minimal supplementation with grain or grain by-products. With grazing, small ruminants can utilize forages with either multi-species grazing or by themselves. Continuous grazing systems are more frequent than either multi-species or management intensive grazing systems. The breed of sheep or goat on a farm will depend on the goals of the farm. Concerns with small ruminants are similar for sheep and goats. The primary concerns are parasite control, predator control, and fencing to limit movement of the small ruminants and to keep predators from the sheep and goats.

Forage Diversity: What are the Options besides Endophyte Infected Tall Fescue?

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People often ask "What can I plant besides Kentucky 31 tall fescue?" A quick count of the species in the "A Guide to the Common Forages and Weeds of Pastures" lists more than 25 forages used in pastures in Missouri besides endophyte-infected tall fescue. Many would be familiar to you: orchardgrass, smooth bromegrass, red clover, white clover, alfalfa and several others. Other species, like crabgrass or turnips, might be less thought of as forages.

Why would you want to have something besides endophyte-infected tall fescue? After all, nothing accepts more abuse and/or persists longer in Missouri than that. And tall fescue works for hay, pasture and the occasional seed crop as well as it can be stockpiled for winter use. Admittedly, those are positive aspects of tall fescue and some of the reasons it is a part of more than 11 million acres of pastures in Missouri. But work since the 1970's has shown that most of the tall fescue in the nation is infected with a wild-type endophytic fungus that produces toxins, specifically ergot-like alkaloids, that limit several aspects of animal production including weight gain, milk production, and conception rates. So while endophyte-infected tall fescue is a hardy and productive plant, it is not the best animal feed.

So what are the options beyond endophyte-infected tall fescue? First in my mind would be endophyte-infected tall fescue. Huh? On the market now are endophyte-infected tall fescue varieties that are infected with "non-toxic" or "beneficial" endophytes. The endophyte in these types of tall fescue provides most of the positive agronomic traits of their wild-type cousins, but do not produce appreciable levels of the toxins that limit livestock production. Researchers and producers across the country have worked with these new types of endophytes and tall fescue for over ten years now, and without a doubt, livestock and agronomic performance has been excellent.

If for some reason you do not want tall fescue at all, there are plenty of other options. Of the cool-season grasses besides tall fescue, orchardgrass and smooth bromegrass are the most common. Orchardgrass matures about 2 weeks before most other cool-season grasses so keeping on top of it in spring is of paramount importance in grazing systems. If used for hay, orchardgrass hay should be made in Southern Missouri before 10 May. Orchardgrass is often susceptible to rust, so choosing a rust resistant variety is a must at planting. In most situations, orchardgrass lives 3 to 5 years in Missouri, unless it is allowed to reseed. Perhaps you have neighbors who brag about how long their orchardgrass field has lasted. Most often these are hay fields that are cut on Memorial Day or later. While the forage quality of late-cut orchardgrass is poor, it does allow the plants to reseed during the haymaking process. This is not a practice we recommend, but it does explain the long-lived orchardgrass fields in many cases.

Smooth bromegrass is another option. While best adapted north of the Missouri River, it can persist several years in southern Missouri. Smooth bromegrass produces large spring yields, but its regrowth during summer is less than for tall fescue or orchardgrass. One reason for the lower regrowth is that smooth bromegrass elevates its growing point in spring more than do other grasses. If this growing point is cut or removed in spring, then

regrowth is often slow. Perhaps more so than any other cool-season grass we commonly use, leaving a 3 to 4 inch stubble on smooth bromegrass helps it regrow quickly after a haying or grazing event. One other limitation to smooth bromegrass; it does not stockpile well for winter grazing. My goal with smooth bromegrass is to have it fully utilized before early November each year.

Another cool-season grass you likely have heard a lot about over the years is perennial ryegrass. World-wide no other cool-season grass is more widely used for livestock. Largely prized for both its productivity and forage quality, it is best adapted to regions with cool summers and mild winters. Unfortunately, we don't always get those in Missouri. What we find happens in our continental climate is that perennial ryegrass lasts somewhere between 3 and 5 years. Perennial ryegrass does not tolerate drought or heat stress well. And while livestock grazing perennial ryegrass often produce well, unless measures are taken to thicken the stand every few years, it does not last as long as other cool-season grasses.

I'll finish my bit on cool-season grasses with one more; reed canarygrass. In my opinion, reed canarygrass is the most under-utilized perennial cool-season grass in Missouri. Well adapted to wet areas, you might be surprised to learn that it is among the most drought tolerant of the perennial cool-season grasses as well. The naturalized or wild-type often used in waterways and other drainage areas is not the best choice here. Wild types of reed canarygrass produce alkaloids that limit animal intake. However, significant breeding progress over the past 30 years has reduced these alkaloids in newer varieties like Palaton II and Venture to name a few. The seedling vigor of reed canarygrass is lower than for other cool-season grasses, so some care needs to be taken at planting to ensure it gets off to a good start. But once started reed canarygrass stands thicken over time due to its rhizomatous nature. Like orchardgrass, grazing on established stands of reed canarygrass should start early to keep forage quality in check.

Okay, let's take a few minutes to discuss something besides cool-season grasses. I'll start with the warm-season grasses next. Of the warm-season grasses available, there are three introduced species and at least four native species in wide-spread use.
Bermudagrass is an introduced perennial warm-season grass used for forage and erosion control in the warmer portions of the United States, including the southern third of Missouri. Under ideal conditions, it can produce 8 tons of feed per acre annually, though 5 tons per acre is more common. Although crude protein levels will often be in the low teens, digestibility of bermudagrass is often less than desired, especially if it is allowed to mature. Most forage types are established from vegetative sprigs; this sometimes makes it difficult and expensive to establish. Seeded types offer ease of establishment, but in general do not produce as much forage and are not as winter hardy. Once established, bermudagrass is aggressive and can crowd out other species, which also makes it a poor choice for wildlife habitat. That said, on high quality sites, no other warm-season grass will be as productive as will bermudagrass.

Caucasian bluestem is an introduced warm-season grass that originates from the Caucasus region of Russia. Used for years in southern Missouri, it tolerates heavy grazing; in fact, for forage quality to be acceptable, caucasian bluestem must not be allowed to grow taller than 6 inches. Its nutritive value plummets if it is not well fertilized with nitrogen or if it is permitted to form seed heads. Caucasian bluestem is also winter-hardy and easier to

establish than many other warm-season grasses. It tolerates shallow and infertile soils better than many other species. However, caucasian bluestem is best grown by itself because of its aggressiveness and its sensitivity to shading.

Crabgrass is another possible choice for warm-season grazing. Crabgrass is easy to establish; just look at my yard sometime! Stands of crabgrass can last almost indefinitely if managed to encourage volunteer reseeding. Although often considered a weed, crabgrass is a high-quality forage that can produce 6,000 to 10,000 lb/acre of dry matter annually. The majority of the dry matter is produced from mid-June to August. Crabgrass is adapted statewide and tolerates poorly drained soils well but is not cold hardy. It responds well to split applications of nitrogen at establishment and then again after the first grazing.
Now on to the native warm-season grasses. There are at least four major native warm-season grasses used for forage in Missouri and several other lesser known ones. In the interest of space I'll focus on these four: switchgrass, big bluestem, indiangrass, and eastern gamagrass.

Switchgrass is a native, perennial warm-season grass grown on an estimated 1 million acres in Missouri. Although its greatest current use is for forage and wildlife habitat, there is significant interest in using it for biofuel. Switchgrass tolerates poorly drained soils fairly well and is adapted to a wide range of growing conditions. It is easier to establish than many other warm-season grasses. Switchgrass dominates in the early years of establishment of mixed native warm-season grass plantings but declines after 10 to 12 years. Switchgrass must be grazed early in the season or the grass easily becomes overmature and of poor quality. Switchgrass is useful if grazing begins early in the season and it is kept in a vegetative stage of growth.

Big bluestem used to be the dominant grass in the native prairies of Missouri. Big bluestem grows statewide, and it is currently found on about 1 million acres in Missouri. It produces good quality hay and will persist indefinitely if properly managed. It is both winter- and drought-hardy and does better in poorly drained soils than some other warm-season grasses. It is also compatible with many other forage species. However, it is slow to establish, and thus weeds can make establishment a problem. It works well in a planned grazing system if it is not allowed to become mature before grazing and if a 6-inch or greater stubble height is maintained to encourage regrowth.

Indiangrass is a native, perennial warm-season grass with a number of uses, from a forage crop to conservation and wildlife habitat. Indiangrass can grow throughout the state, but it is best grown in mixtures with other native warm-season grasses. It matures two or three weeks later than big bluestem, and because it does not begin reproductive growth until later in the season, it can be of high quality both as pasture and hay. However, Indiangrass has trouble establishing itself without proper weed control and does not grow well in poorly drained areas. Its weaknesses are that it does not produce abundant forage until late in the season and has poor regrowth potential.

Eastern gamagrass, the king of bunchgrasses, is used for pasture, hay and silage. It grows well in wetter areas but prefers deep, well-drained soils. Eastern gamagrass lends itself to pasture-based operations because it has a more even distribution of yield over the grazing season than do many other warm-season grasses. It also has better forage quality than many other warm-season grasses. Despite these advantages, eastern gamagrass has a few

problems. Seed production is difficult, and gamagrass is slow to establish. Furthermore, it is easily overgrazed. Eastern gamagrass grows well throughout Missouri but is most popular in the central and western regions of the state.

And now finally, we move on to the legumes. There are several legumes that can and should be a part of forage systems in Missouri. Though most can be grown in pure stands, more often legumes are added to grass stands to improve forage quality. Most legumes do not live as long as perennial grasses, so maintaining stands though good grazing management techniques and reseeding as necessary are often recommended.

Alfalfa is a perennial legume that is one of the most important forage crops in the United States. Generally used for hay or silage, it is increasingly used to provide high-quality pasture in rotational grazing systems. In a mixture with novel-endophtye infected tall fescue, we have produced more than 500 lb/acre of beef per year. Its deep root system allows it to withstand drought better than most other legumes. Alfalfa grows well with other grasses in a mixture. However, alfalfa grown alone can cause bloat in grazing animals, and alfalfa itself is prone to a number of insect and disease problems. Alfalfa produces and persists poorly on shallow or poorly drained soils and should not be planted on such sites.

Birdsfoot trefoil is a short-lived perennial legume capable of producing high-quality forage on soils where other legumes do not survive. Although it generally yields less than red clover and alfalfa when cut for hay, it often gives better performance than these legumes when grown in a grass/legume pasture. Unlike many other perennial legumes, birdsfoot trefoil does not cause bloat in cattle. However, it does not tolerate continuous grazing or frequent haying. It is also prone to a number of diseases and pests that make management for reseeding essential. Although birdsfoot trefoil grows statewide, it is most often used in northern Missouri.

Red clover is a short-lived, perennial legume grown on 7–10 million acres in Missouri. Although alfalfa has superior yield and quality under ideal conditions, red clover is much better adapted to the poorly drained, shallow or infertile soils frequently found on pasturelands. It is easier to establish than other legumes and works well in a mixture with cool-season grasses. It has problems dealing with prolonged drought and root diseases. However, it can be reseeded rather easily and inexpensively. In fact, many producers broadcast 3 to 6 lb/acre of seed annually to maintain stands.

White clover is a legume adapted to cool, moist climates. In Missouri, it is presently grown on about 8 million acres of pastureland in combination with perennial cool-season grasses. Like other legumes, the forage it provides is both palatable and nutritious. All cattle relish white clover but have a tendency to overgraze it in mixed pastures. A rotational grazing system helps manage this problem. White clover has good tolerance to poorly drained soils, but it is not drought-tolerant. In addition, white clover causes cattle to bloat if used as the only forage in the diet. Because of its high forage quality, white clover has wide application in grazing systems.

Annual lespedeza is primarily used as a pasture legume, although it is sometimes cut for hay. It provides high-quality forage in midsummer when other cool-season grasses and legumes are struggling. It also grows better than other legumes on infertile or shallow soils. Like birdsfoot trefoil, it does not cause bloat. However, it is not problem-free. Its annual

yield is lower than that of other legumes, and it does not have as broad a window of forage production. Korean types have proven susceptible to a number of foliar diseases. Annual lespedeza can be valuable in July and August.

Okay, that is my treatise on what you can use besides tall fescue. There are a lot. One last piece of advice. Don't try out everyone of these this season. Pick out one, perhaps two, that you think could fit your operation. Learn all you can about the establishment and management of this new-to-you forage. Then try it on a few acres to get some experience before you replant the whole farm.

UNIVERSITY OF MISSOURI
Extension

Pasture Weed & Brush Control

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Weeds and brush can be and in many cases are serious problems in pastures in southwest Missouri. Reasons for controlling weeds and brush in our pastures and hay fields include the fact that they can reduce the quantity and quality of the desired forage species. Certain species such as blackberries, dewberries and thistles may exclude livestock from grazing certain areas or consuming contaminated hay.

Control Methods

There are several methods to control weeds and brush including cultural, mechanical, biological and chemical. These methods can be used alone or in most cases in combination with each other.

Cultural methods are basically management practices that promote a vigorous, healthy stand of the desired forage. They include proper forage variety selection, good fertilization practices, maintaining an adequate pH and good harvest management, whether by grazing or haying. Soil testing to insure the soil pH, phosphorus and potassium levels are adequate for the forage species is essential.

Mechanical control most often refers to mowing or brush hogging. In combination with other control methods such as good fertilizer and liming practices and herbicides, mowing can be an effective tool in weed and brush management. When used alone, mowing hides a problem but rarely gives good control. Mowing brush like sumac, hedge (Osage Orange) or honey locust can actually make the problem worse. A person can gain slow control over blackberries by timely mowing; namely, from full leaf to blossom in the spring. Even with proper mowing, one should expect control to take several years to make meaningful progress. A late-season mowing of blackberries or other species of brush is only cosmetic and will give no long-term control.

Biological control can be used to control targeted weed species. The targeted species in southwest Missouri is the musk thistle. The introduction of the musk thistle head and rosette weevils has been very effective in reducing the population in Southwest Missouri.

Chemical control involves the use of selective herbicides, and generally provides the most effective control of troublesome weeds once they have become established. Before using any herbicide, read and follow label directions to determine appropriate rates, carrier volume and spray additives. Caution: The herbicides listed are safe on most grasses when used at labeled rates but will kill or injure legumes in a mixed (grass/legume) pasture.

Application

With any application method utilizing a sprayer, be sure to take the time to calibrate the sprayer and ensure that the sprayer is in good working condition. Directions for calibrating boomed and boomless sprayers are available.

Surfactants are often recommended by the herbicide manufacturer and will be clearly stated on the label if needed. These products may help the herbicide to have better coverage of on leaf surface and reduce surface tension of the water they are sprayed in. The most common surfactant recommended is a non-ionic surfactant. The use of ammonium sulfate is also recommended when using glyphosate, which takes hardness out of the water used in the spray.

Foliar broadcast is the use of a boom type sprayer, boom-buster nozzle, airplane, or helicopter to treat larger weed infestations. Herbicides are usually mixed with water.

With the foliar broadcast, good coverage is essential. Generally, a spray volume of 15 to 20 gallons per acre by ground or 3 to 10 gallons per acre by air is desirable. Check the herbicide label for recommended spray volumes. Foliar applications may not be effective if plants are under stress from drought or other conditions. Do not use diesel as a carrier with foliar applications.

Spot treatment is treating the foliage of individual plants or small areas of infestation. It is usually accomplished with a hand sprayer or handgun. Thorough coverage is essential with many species and herbicides and some desirable vegetation can be damaged if contacted by the spray.

Basal bark treatment is applying herbicide to the lower 12 to 18 inches of the trunk. This type of treatment works best on trees 6 inches or less in diameter. Herbicides will be mixed with oils or diesel and applied until bark is saturated.

Cut stump is the application of herbicide to the freshly cut surface of the brush or tree. Apply treatment immediately after cutting for maximum effectiveness. On trees larger than three inches in diameter, only the outer cambium layer next to the bark will need to be treated.

Selected Species

Timing of application is crucial for successful control. Refer to Table 3 for a calendar of best times to control specific weeds. The following scenarios are based on experience and do not include all possible treatments.

Thistles (Musk, Bull, Tall) – Cimarron, Cimarron Max, Banvel, Grazon P+D, Milestone, GrazonNext and Tordon 22K have provided good results. If application is made during the rosette stage of growth (fall or early spring), 2,4-D gives good control but offers no residual activity. Do not spray thistles after flower buds begin to develop. At that stage, leave control to the musk thistle weevil.

Chickweed – Use 2,4-D or Grazon P+D in the fall or Grazon P+D in the early spring

Henbit – Use Banvel or Clarity in the fall or early spring.

Poison Hemlock – Use Tordon 22K (1 pt/A) or Grazon (1 qt/A) before it bolts in the early spring. It may also control it in the fall in the rosette stage.

Spotted Knapweed – Use Milestone (5-7 oz/A), Tordon 22K (1 pt/A) or Grazon (2 qt/A) in the rosette to bud stage. Treat before it gets 12" tall.

Plantain (Broadleaf, Buckhorn, Bracted) – Use 2,4-D ester or Grazon P+D (1 qt/A) in the fall or early spring

Buckbrush – Spray plants before leaves reach full size, typically mid to late April. Herbicides effective on buckbrush are Cimarron (0.4 oz/A or 1 oz/100gal), the various forms of 2,4-D (1-2 qt/A or 2% v/v mix) and other formulations containing 2,4-D. GrazonNext has shown some good activity on buckbrush. Do not use spray additives or soaps with 2,4-D as they may reduce the level of control.

Perilla Mint – Use 2,4-D, Grazon P+D or Remedy Ultra while actively growing.

Blackberry / Dewberry – Foliar applications of Cimarron (0.5 oz/A or 1 oz/100gal), PastureGard (4 pt/A) and Remedy Ultra (1-2 pt/A or 1% v/v mix) have given good results. MU research has found that Cimarron worked best post-flower and PastureGard was better mid-flower. Banvel is recommended at the rate of 1 to 2 quarts per acre broadcast. Good results have been found with 1 pt/A Remedy Ultra tank mixed with 1 qt/A Grazon P+D. Treat when blackberries are flowering. Canes should have two or more years of growth. Spraying one year will not give good control of blackberries. It generally takes three or more applications to get adequate control.

Honey Locust – Foliar applications of Grazon P+D (1-2 qt/A or 2% v/v mix) mixed with Remedy Ultra or Surmount gives excellent control of small sprouts. Total coverage of the leaves is essential. Multiple mowings (3 to 4 per year over several years) can give acceptable levels of control. For larger trees, basal bark treatments with Pathfinder II or cut stump treatment with Tordon RTU give acceptable levels of control to smaller trees.

Horsenettle (Bullnettle) – Tordon 22K (1 pt/A) or Grazon P+D (1 qt/A) have given best results on the control of horsenettle. Seed in the ground can make it a perennial problem.

Osage Orange (Hedge) - Remedy is somewhat effective as a foliar treatment. Best control may be achieved with basal bark treatments of Pathfinder II or cut stump treatments with Tordon RTU. Double girdling the tree near the base about an inch deep and then treating the girdled area with Tordon RTU or Pathfinder II can be effective.

Oaks – Use Remedy Ultra when oaks are actively growing after new leaves have expanded in the spring. May be difficult to control.

Sassafras – Very difficult to control. Use Remedy Ultra as basal treatment. Tordon 22K will do a fair job as a foliar treatment. Another good option is a Grazon and Remedy Ultra combination.

Persimmon – Use Surmount, Grazon P+D or Tordon 22K in May or early June. Surmount is a preferred product for this species. Very difficult to control.

Sumac – Use Crossbow or Remedy Ultra when actively growing. 2,4-D works well if applied early.

Red Cedar – Although a few herbicides have been used to control red cedars, the most common and cost effective means of control are cultural or mechanical. Because the bark is very thin, red cedar is extremely sensitive to fire. Prescribed fires are the easiest and most cost-effective control method for red cedar. Small trees are killed if enough fuel surrounds the tree. For trees

larger than three feet in height, any form of cutting below the lowest branch, girdling or removing all of the needles will kill the tree. Tordon 22K may work well on cedars smaller than four feet.

Sericea Lespedeza – PastureGard (2 pt/A), Cimarron(0.4 oz/A or 1 oz/100 gallons of spray solution) and Remedy Ultra (1-2 pt/A or 1% v/v mix) are recommended for control of sericea lespedeza. PastureGard has shown very consistent control in test plots. Apply when sericea is 12 or more inches in height which usually occurs sometime in June. May also apply from bud to flowering. This usually occurs in late August to early September. Do not apply if sericea is under drought stress. Seed in the ground can make it a perennial problem for a few years.

Spiny pigweed (Amaranth)—Use a mixture of 2,4-D and Banvel /Clarity, Grazon P+D (1 qt/A). Residual activity of Grazon P+D keeps the remaining seeds from sprouting that year.

Multiflora Rose—For a broadcast application, spray Tordon 22K (1 pt/A). Spot treat with a 1% solution of Remedy Ultra, Tordon 22K or PastureGard when in full bloom. Soil treatment with Spike pellets.

Tall Ironweed—Spray PastureGard or Remedy Ultra. Some control can be achieved with Grazon P+D (2-3 pt/A) or Tordon 22K (1 pt/A) just prior to or at bud stage and control will be enhanced with the addition of Remedy Ultra.

Prickly Pear Cactus – Use Surmount (2-3 pt/A) or Tordon 22K. Effectiveness of the treatment may be enhanced if the leaf surface area is damaged by mowing or running a light harrow over the plant prior to treatment. Some labels prefer a fall treatment.

Johnsongrass – Selective herbicide options on grass pastures don't exist. Glyphosate works well on Johnsongrass when it is actively growing and not stressed but will destroy the forage stand. To protect desirable grass species and legumes, use a weed wiper. A Glyphosate burndown application followed by reestablishment of the pasture may be the best option.

Effective control of many pasture weed species such as pigweeds, common and giant ragweed, asters, cocklebur, plantains, bitter sneezeweed and woolly croton may be achieved with 2,4-D if applied during good conditions for weed control.

Below are recommended MU Guides that can be obtained through MU Extension Centers:

G4852	Cleaning Field Sprayers to Avoid Crop Injury
G4970	Plants Poisonous to Livestock
IPM 1010	Biological Control of the Musk Thistle in Missouri
M 169	A Guide to the Common Forages and Weeds of Pastures
MP581	Weed and Brush Control Guide for Forages, Pastures and Non-Cropland.

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Table 1. Common Pasture Herbicide Brands

Single Ingredient Products

2,4-D – Weedar 64; Weedone LV4; Opti-Amine; HiDep; etc.
dicamba – Banvel; Clarity
triclopyr – Remedy Ultra; Relegate; Clear Pasture
picloram – Tordon 22K; Trooper 22K; Triumph 22K, Outpost 22K
metsulfuron – Cimarron; Purestand (Follow directions closely. This can be hard on fescue)
aminopyralid – Milestone

Packaged Mixes

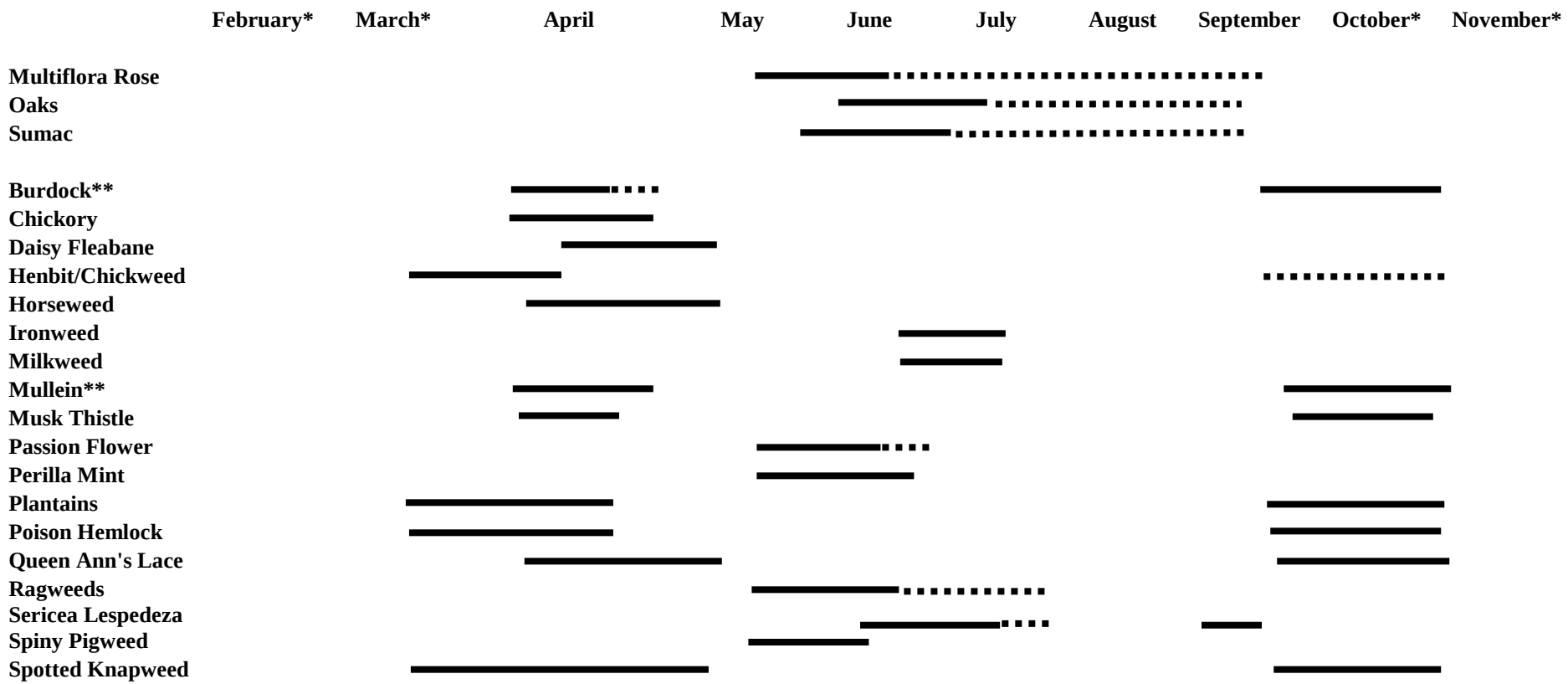
2,4-D + dicamba – Weedmaster; Rangestar
picloram + 2,4-D – Grazon P+D; Gunslinger; Hired Hand
triclopyr + 2,4-D – Crossbow; Candor; Crossroad
triclopyr + fluoxypyr - PastureGard
picloram + fluoxypyr - Surmount
aminopyralid + 2,4-D – GrazonNext (formerly marketed as ForeFront)
metsulfuron + dicamba + 2,4-D – Cimarron Max (Follow directions closely. This can be hard on fescue)
metsulturon + aminopyralid – Chaparral (Follow directions closely. This can be hard on fescue)

Table 2. Restrictions for some common pasture weed and brush herbicides.

Herbicide	Grazing and Haying Restrictions Following Application (Days)					Interval Between Application and Planting	
	Beef		Lactating Dairy		Removal of meat animals before slaughter	Forage Grasses	Alfalfa / Clovers
	Grazing	Haying	Grazing	Haying			
2,4-D amine or ester*	0	0	7	30	3	NGS	NGS
Banvel / Clarity							
up to 1 pt / ac	0	0	7	37	30	see label	see label
up to 2 pt / ac	0	0	21	51	30		
up to 4 pt / ac	0	0	40	70	30		
Chaparral	0	0	0	0	-	12 mo.	FB
Cimarron (0.1-0.2 oz)	0	0	0	0	0	fescue18 mo.	12 mo.
Cimarron Max (Rate 1)	0	0	7	37	30	fescue18 mo.	12 mo.
Crossbow*	none	14	<2 gal - 14	next season		21 days	NGS
GrazonNext	-	7	-	7	-	-	FB
Glyphosate*							
renovation	56	56	56	56	0	anytime	anytime
spot application	14	14	14	14	0	anytime	anytime
Grazon P + D*	0	30	7	30	3	FB	FB
Tordon 22K*	0	>1 qt. - 14	14	14	3	FB	36 mo.
Milestone	0	0	0	0	-	-	FB
PastureGard	0	14	next season	14	3	120 days	1 mo.
Remedy Ultra*	0	14	next season	14	3	-	-
Spike (spot treatment)	0	1 year	0	1 year	0	> 2 years FB	> 2 years FB
Surmount	0	7	14	14	3	1 year	FB
Weedmaster	0	37	7	37	30	see label	see label

The label is the final word on all restrictions. Verify all information with the label on your container.
FB – Field bioassay required prior to establishment; NGS – Next Growing Season
* A variety of trade names exist. Check product labels for specific restrictions. 8/24/10

Table 3. Best times to control specific weeds with herbicides.



***** **Observe temperature restrictions on herbicides**

****** **Treatment should be applied in the rosette stage of growth**

Optimum period for control

Reduced control or higher rates of herbicide required

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