Section 10

Extending the Grazing Season and Critically Evaluating Novel Grazing Systems

Dr. Dennis Hancock, UGA

2016 Georgia Grazing School:

Extending the grazing season and critically evaluating novel grazing systems

Dr. Dennis Hancock
Assoc. Prof. & Forage Ext. Specialist

Extending the grazing season and critically evaluating novel grazing systems

GRASS

Dr. Dennis Hancock
Extension Forage Specialist
Crop and Soil Sciences – UGA

How Much Hay Do I Need?

Hay Acreage Required

$$\frac{\text{Head x lbs of b.w. x DMI, \% of b.w. x days}}{\text{Forage Use Efficiency x Hay Yield/acre}} = \text{Acres Required}$$

Hay Acreage *"Required"*

$$\frac{\text{100 hd x 1500 lbs/cow x 2.0\% x 120 days/yr}}{\text{70\% efficiency x 12,000 lbs/acre/yr}} = \text{43 acres}$$

Costs of Feeding Hay

$$\text{1500 lbs/cow} \times \frac{\text{2.0 lbs of hay}}{\text{100 lbs of b.w.}} = \text{30 lbs/hd/d}$$

X

$$\frac{\text{\$100/dry ton of hay}}{\text{2000 lbs}} = \text{\$0.05/lb of hay}$$

$1.50/hd/d

Also,
Subtract an average of:

15% feeding loss
30% storage loss
15% other losses

$1.75 - $2.00 per head per day

Costs of Feeding Hay

$2.00/hd/d

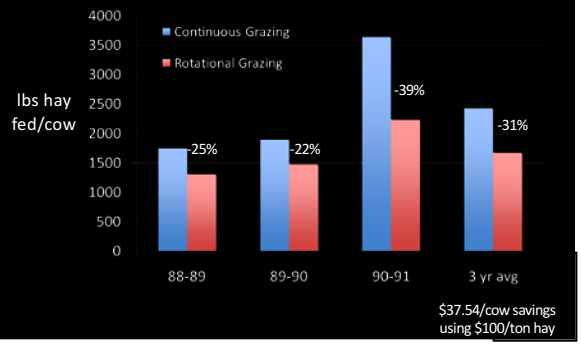
I have 100 cows.

If I cut out 30 days of feeding hay… ?

100 cows x $2.00 x 30 days = **$6000**

That's like having a 5-7% increase in your calf crop!!!

Effect of Grazing System on Hay Needs



$37.54/cow savings using $100/ton hay

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Grazing School

UGA extension

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Grazing School Goals:

1. Provide a more comprehensive coverage of grazing management.
   - "Unlearn" much of the conventional wisdom about grazing.
2. Provide you the tools to develop a more efficient grazing system.
3. Encourage you to reduce your conserved forage (e.g., reduce hay feeding to less than 60 days).
   - 300 Days of Grazing

The Primary Calculations

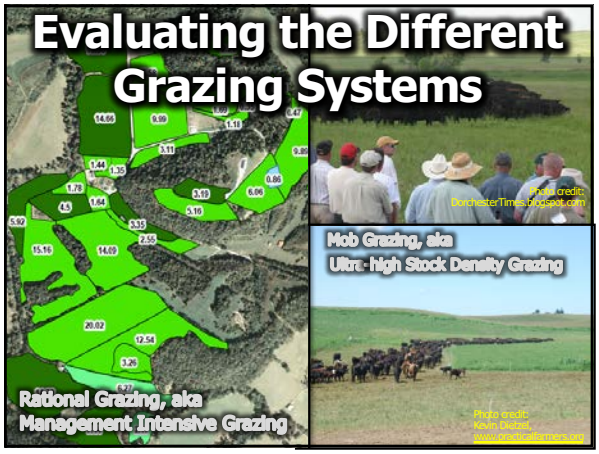
$$\text{Acres Grazed per yr} = \text{Paddock Size} \times \text{Number of Paddocks}$$

$$\text{Paddock Size} = \frac{\text{Animal Weight} \times \%\text{DMI} \times \text{Head} \times \text{Days in Paddock}}{\text{Rationed Forage} \times \text{Grazing Efficiency \%}}$$

$$\text{Number of Paddocks} = \frac{\text{Days of Rest}}{\text{Days in Paddock}} + 1$$

Grazier's Arithmetic: A Grazing Calculator

Evaluating the Different Grazing Systems



Analyzing Strategic Changes

$$\text{Acres Grazed per yr} = \left(\frac{\text{Days of Rest}}{\text{d in Paddock}} + 1\right) \times \frac{\text{Animal Weight} \times \%\text{DMI} \times \text{Hd} \times \text{d in Paddock}}{\text{Available Forage}_{\text{diff}} \times \text{Grazing Efficiency \%}}$$

- Examples:
  - Changes in grazing system, forage rest period, etc.
  - Changes in supplementation rate
- But, remember that the system is very dynamic!

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Stockpiling Tall Fescue or Bermudagrass "Average" Expectations

INPUTS

- Moisture
- N fertilizer (up to 60#/ac for TF; up to 80# for BG)
- More than typical grazing management
  - Improved bermudagrass

OUTPUTS

- 1500-3500+ lbs of standing dry matter (DM)/acre.
  - 30 – 60 days (more or less, depending on grazing method and weather)
- CP levels starting in 8 – 12% range, ending below 10%
- TDN levels ranging 55-58%

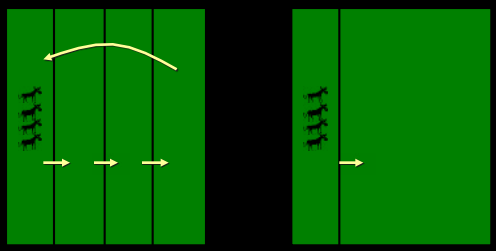
Stockpiling Tall Fescue or Bermudagrass Steps Involved

1. Graze or take hay cutting (2-3")
   - TF: Early to mid-Sept.
   - BG: about 6-8 wks prior to first anticipated frost.
2. Add fertilizer like making a hay cutting.
3. Don't allow it to be grazed (if possible) until:
   - TF: After Thanksgiving
   - BG: After first killing frost

Stockpiling Tall Fescue or Bermudagrass Steps Involved

4. Measure amt. of stockpiled forage that is available.
5. Take forage samples to determine supplement need.
6. Only let them have small strips (no more than 2-3 days worth) at a time (frontal grazing).
   - Each 1200 lb cow will need ~35-40 lbs of stockpile/day
   - Allow access to mineral, ionophore, and supplement as needed.

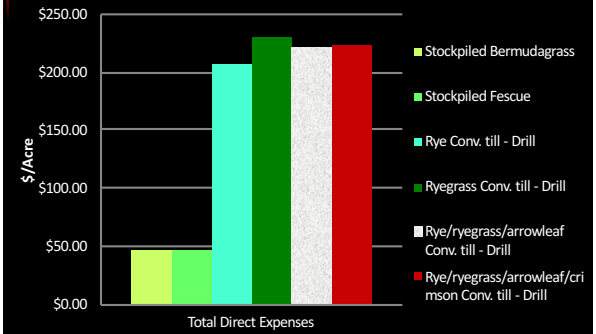
Grazing Methods



Grazing Methods

Available Forage	Continuous Stocking	Moderate Rotational Stocking	Frontal Grazing
(dry lbs/acre)	(cow-days/acre)		
1500	19-25	31-38	41-47
2000	25-33	42-50	54-63
2500	31-42	52-63	68-78

Cost Comparison for Extended Grazing Options



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Grazing Crop Residue

- Very inexpensive feed
- Can last for several days
  - Frontal grazing makes for efficient utilization
- Corn residue: 1 cow/acre for 60-100 days
- Cotton residue: 1 cow/acre for 30-35 days

Grazing Cotton Residue

Item	Hay	Standing Residue	Mowed Residue

* Hay valued at $70/dry ton. 1 cow/acre for 44 days. Data from Plains, GA.

Grazing Crop Residue

- Check pesticide labels
- Check fence rows and weed species for poisonous plants
- No difference in animal performance between Bt and non-Bt crops.

Other Winter Annuals

Brassicas (Turnips, Rape, Swedes, Hybrids)

Forage Turnips

January 2008

Brassicas

Type[1]	November 21	January 24	March 26	Total
	lb/ac			
Rape				
Barnapoli	812	2898	4257	7968
Bonar	924	2630	4222	7776
Dwarf Essex	1232	3121	4855	9209
T-Raptor	1799	4112	6211	12123
Turnips				
Appin	1571	2657	3928	8256
Barabas	1402	1746	1957	5105
Barkant	1241	1902	2434	5577
FL Broadleaf	1512	2505	3473	7491
Pasja	1420	3661	5761	10842
Purpletop	2375	2201	3389	7965
$LSD_{0.05}$[2]	560	445	532	866

[1]Planted at 5 lb/ac and fertilized with 400 lb of 15-5-10 at planting and after each harvest.
[2]LSD = Least Significant Difference. LSD for comparison of varieties within each column.
Source: Lang et al., 2007. Brassicas as Alternative Winter Forage for Mississippi. Mississippi State Univ.

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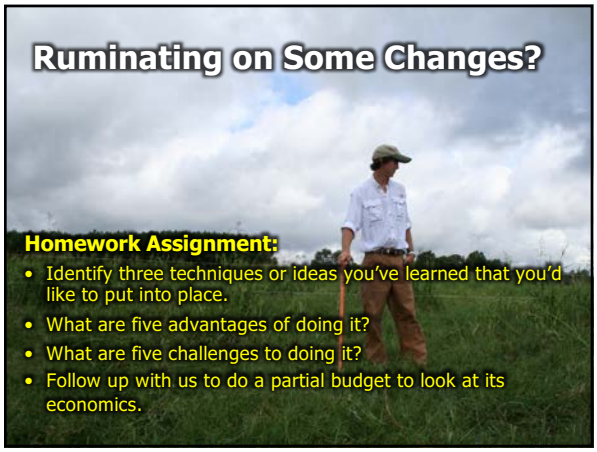

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Section 11

Cost-Share Programs That Aid the Transition

Craig Bevan, USDA-NRCS

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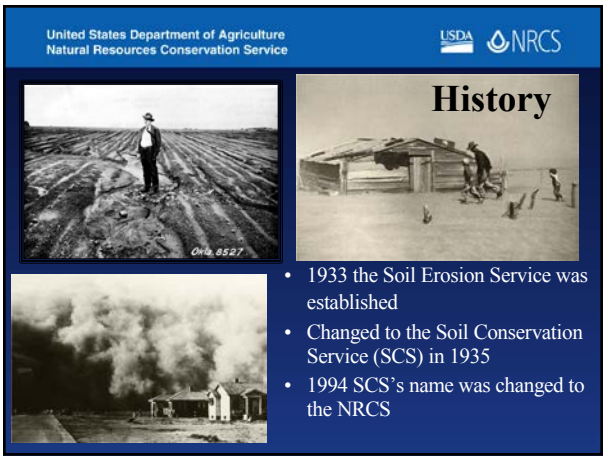
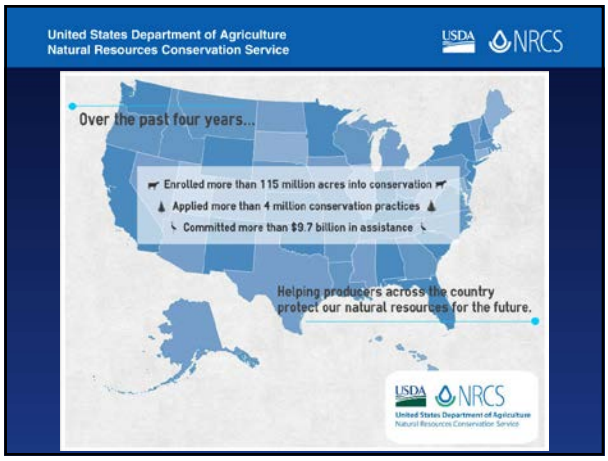
Cost-share programs that aid the transition

Craig Bevan
USDA-NRCS District Conservationist





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USDA-NRCS District Conservationist

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CTA– Conservation Technical Assistance

- Provide technical assistance in...
  - the development of conservation plans designed to address specific resource concerns
  - design & engineering
  - implementation of techniques used to reduce soil erosion, improve water quality, and protect natural resources

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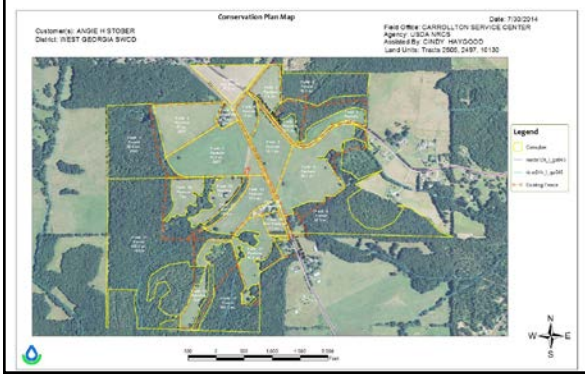
Natural Resources Conservation Service



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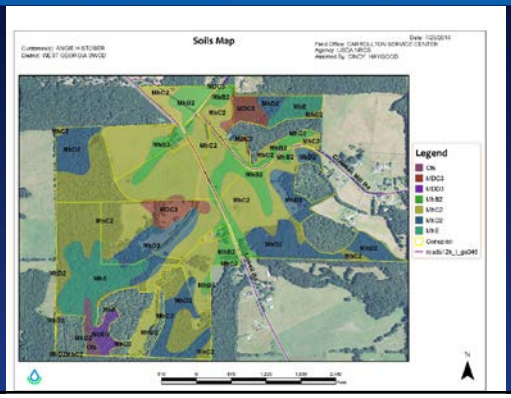

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NRCS Specialists

- Soil Conservationist
- Grazing Land Specialist
- Agronomist
- Geologist
- Forester
- Biologist
- Engineers
- Soil Scientists

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Natural Resources Conservation Service

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Environmental Quality Incentives Program (EQIP)

- Financial assistance payments for structural, vegetative, and land management practices to address resource concerns related to soil, water, air, plant and animals

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Erosion Control

- Grassed Waterway
- Diversion
- Critical Area Treatment

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- Overall Objective for Grazing Lands
- Develop a grazing system and plan that allows you to manage the intensity and frequency of grazing

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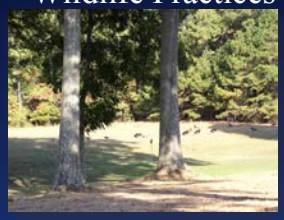
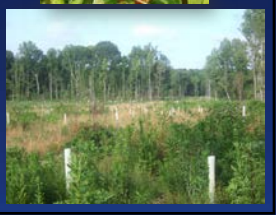
Wildlife Practices





- Pollinator habitat
- Upland Wildlife Management
- Tree planting (wildlife)

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Forestry Practices

- Site Preparation and Tree Planting
- Prescribed Burning
- Forest Trails and Landings (Water Bars)
- Precommercial Thinning
- Brush Management (Release)

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CAFO Practices

- Waste Management Structures/Composters
- Nutrient Management Plans

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Conservation Stewardship Program (CSP)

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Agricultural Conservation Easement Program (ACEP)

FRPP GRP WRP

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High Tunnel Initiative

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Energy Initiative

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Longleaf Pine Initiative

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Program Details

- Continuous sign up process
- Land and Participant must be eligible
- Ranked to measure resource needs & environmental benefits gained
- Not all applications are funded-limited funding annually
- Can always re-submit an application

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Summary of NRCS Technical and Financial Assistance

- Voluntary – You volunteer to follow standards and other Farm Bill Rules
- Address resource concerns
- Standards for how each conservation practice is to be installed and used
- Financial assistance comes with obligation and accountability

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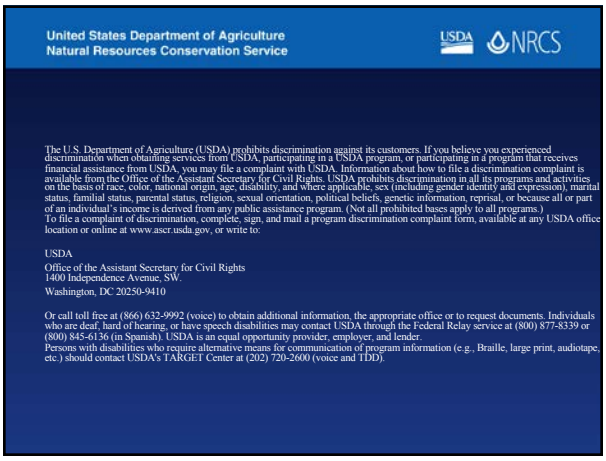

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Natural Resources Conservation Service (NRCS)

LOCATE YOUR LOCAL SERVICE CENTER

COUNTY	LOCATION	PHONE
Appling, Bacon, Jeff Davis	Baxley	912-367-6684
Atkinson, Charlton, Pierce, Ware	Blackshear	912-449-6273
Baker, Dougherty, Mitchell	Albany	229-430-8509
Baldwin, Greene, Hancock, Putnam, Taliaferro	Greensboro	706-453-7021
Banks, Jackson, Madison	Commerce	706-335-7145
Barrow, Clarke, Oconee, Walton	Monroe	770-267-1359
Bartow, Cherokee, Gordon, Pickens	Calhoun	706-629-2582
Ben Hill, Irwin, Tift, Turner	Tifton	229-382-4776
Berrien, Clinch, Cook, Echols, Lanier, Lowndes	Nashville	229-686-5557
Bibb, Crawford, Peach, Taylor	Fort Valley	478-827-0016
Bleckley, Dodge, Twiggs	Eastman	478-374-2531
Brantley, Camden, Glynn, Wayne	Brunswick	912-265-8043
Brooks, Thomas	Thomasville	229-228-0459
Bryan, Chatham, Liberty, Long, McIntosh	Richmond Hill	912-459-2350
Bulloch, Candler, Tattnall, Evans	Statesboro	912-871-2605
Burke, Columbia, Jenkins, Richmond	Augusta	706-724-2247
Butts, Clayton, Henry, Fayette, Spalding	McDonough	770-957-5705
Calhoun, Early, Miller	Blakely	229-723-3825
Carroll, Haralson, Heard	Carrollton	770-832-8942
Chattahoochee, Harris, Marion, Muscogee, Talbot	Buena Vista	229-649-3131
Clay, Quitman, Randolph	Cuthbert	229-732-6211
Cobb, Douglas, Fulton, Paulding	Marietta	770-792-0594
Coffee, Telfair	Douglas	912-384-4811
Colquitt, Worth	Moultrie	229-985-5399
Coweta, Meriwether, Troup	Newnan	770-251-4283
Crisp, Dooly, Wilcox	Cordele	229-443-0182
Dade, Catoosa, Murray, Walker, Whitfield	LaFayette	706-638-2207
Dawson, Forsyth, Hall, Lumpkin	Gainesville	770-536-6981
DeKalb, Gwinnett, Rockdale	Lawrenceville	770-963-9288
Decatur, Grady, Seminole	Bainbridge	229-567-3994
Effingham, Screven	Sylvania	912-564-2207
Elbert, Franklin, Hart	Hartwell	706-376-5451
Emanuel, Montgomery, Toombs, Treutlen, Wheeler	Swainsboro	478-237-8037
Fannin, Gilmer, Rabun, Towns, Union	Blairsville	706-745-2794
Floyd, Chattooga, Polk	Rome	706-291-5651
Glascock, Jefferson, McDuffie, Warren	Louisville	478-625-7771
Habersham, Stephens, White	Toccoa	706-779-2134
Houston, Macon, Pulaski	Perry	478-987-2280
Jasper, Jones, Morgan, Newton	Madison	706-342-1315
Johnson, Washington	Sandersville	478-552-6073
Lamar, Monroe, Pike, Upson	Barnesville	770-358-0787
Laurens, Wilkinson	Dublin	478-275-0425
Lee, Terrell	Dawson	229-995-5811
Lincoln, Oglethorpe, Wilkes	Washington	706-678-2630
Schley, Stewart, Sumter, Webster	Americus	229-924-4056

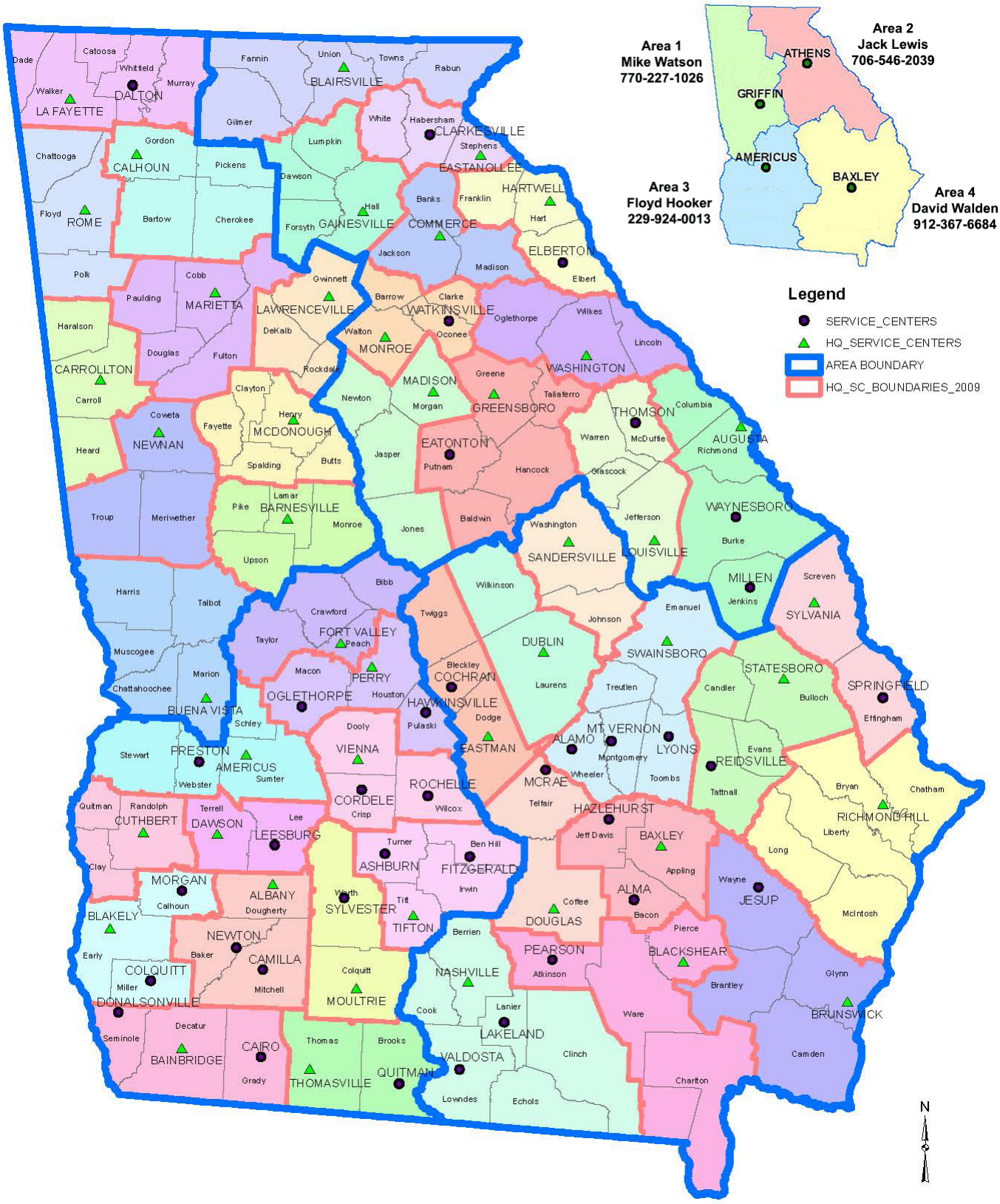
Visit the Georgia NRCS Web site at www.ga.nrcs.usda.gov.

As of July 2016

USDA

United States Department of Agriculture

Natural Resources Conservation Service
Georgia Service Center Administrative Areas (SCA)



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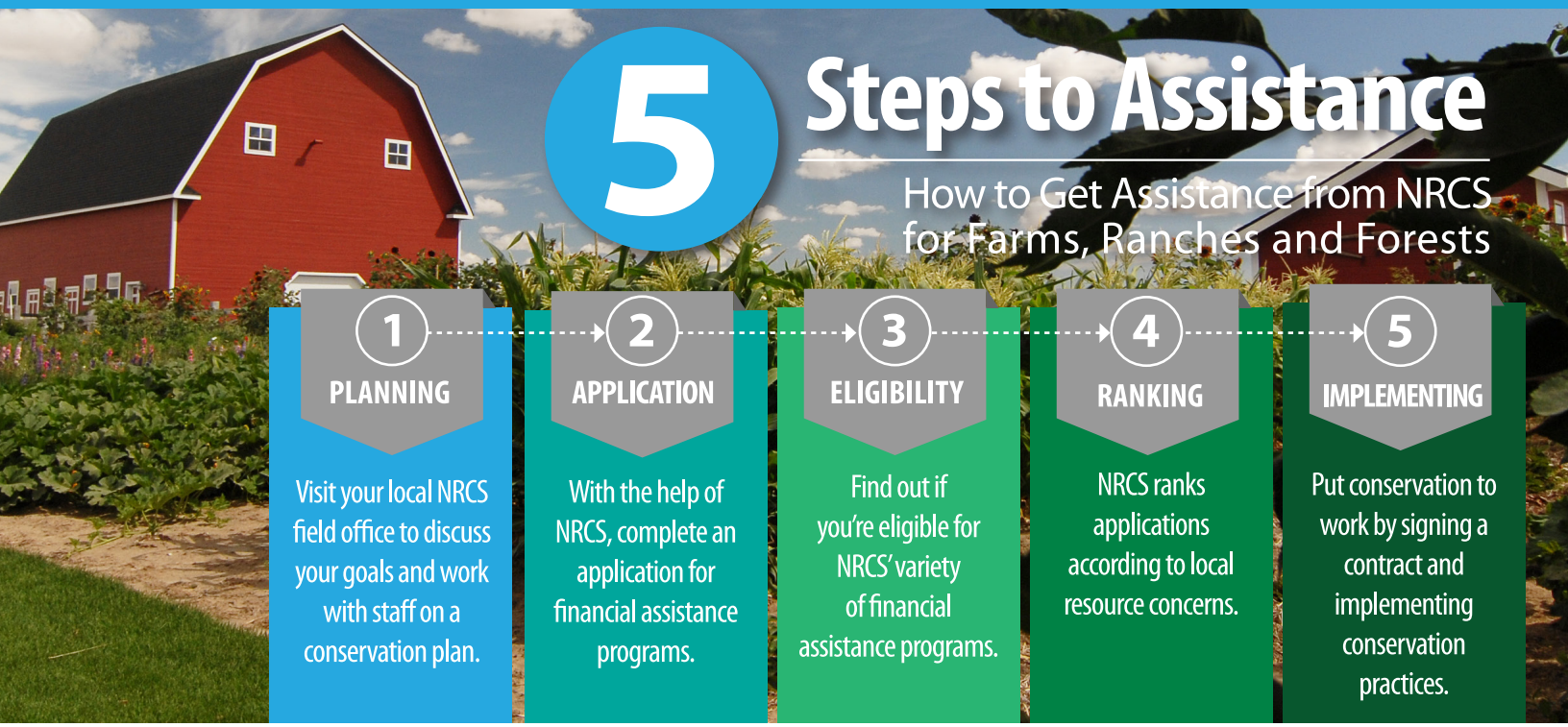

5 Steps to Assistance

How to Get Assistance from NRCS for Farms, Ranches and Forests

1. **PLANNING** — Visit your local NRCS field office to discuss your goals and work with staff on a conservation plan.
2. **APPLICATION** — With the help of NRCS, complete an application for financial assistance programs.
3. **ELIGIBILITY** — Find out if you're eligible for NRCS' variety of financial assistance programs.
4. **RANKING** — NRCS ranks applications according to local resource concerns.
5. **IMPLEMENTING** — Put conservation to work by signing a contract and implementing conservation practices.

Get Started with NRCS

Do you farm or ranch and want to make improvements to the land that you own or lease?

Natural Resources Conservation Service offers technical and financial assistance to help farmers, ranchers and forest landowners.

1 Planning

To get started with NRCS, we recommend you stop by your local NRCS field office. We'll discuss your vision for your land.

NRCS provides landowners with free technical assistance, or advice, for their land. Common technical assistance includes: resource assessment, practice design and resource monitoring. Your conservation planner will help you determine if financial assistance is right for you.

2 Application

We'll walk you through the application process. To get started on applying for financial assistance, we'll work with you:

- To fill out an AD 1026, which ensures a conservation plan is in place before lands with highly erodible soils are farmed. It also ensures that identified wetland areas are protected.
- To meet other eligibility certifications.

Once complete, we'll work with you on the application, or CPA 1200.

Applications for most programs are accepted on a continuous basis, but they're considered for funding in different ranking periods. Be sure to ask your local NRCS district conservationist about the deadline for the ranking period to ensure you turn in your application in time.

USDA is an equal opportunity provider and employer.

3 Eligibility

As part of the application process, we'll check to see if you are eligible.

To do this, you'll need to bring:

- An official tax ID (Social Security number or an employer ID)
- A property deed or lease agreement to show you have control of the property; and
- A farm tract number.

If you don't have a farm tract number, you can get one from USDA's Farm Service Agency. Typically, the local FSA office is located in the same building as the local NRCS office. You only need a farm tract number if you're interested in financial assistance.

4 Ranking

NRCS will take a look at the applications and rank them according to local resource concerns, the amount of conservation benefits the work will provide and the needs of applicants.

5 Implementing

If you're selected, you can choose whether to sign the contract for the work to be done.

Once you sign the contract, you'll be provided standards and specifications for completing the practice or practices, and then you will have a specified amount of time to implement. Once the work is implemented and inspected, you'll be paid the rate of compensation for the work if it meets NRCS standards and specifications.

To find out more, go to: **www.nrcs.usda.gov/GetStarted**

WHAT'S NEXT?

WHAT SHOULD I EXPECT NOW THAT I AM IN A CONSERVATION PROGRAM?

NRCS requires the participant adhere to the following once they enter into a Conservation Program Contract (CPC):

1. Start at least one practice in the contract within the first 12 months of the contract. **Note: Secure prior approval from NRCS before initiating construction on practices requiring an engineering design.**
2. Complete contract items as scheduled in the CPC. Contract items may be accomplished anytime prior to the year scheduled. (Exception: Conservation Stewardship Program (CSP) contract items do not have funds obligated to them ahead of schedule and therefore cannot be completed in advance.) If a practice will not be completed on schedule, you will need to contact your local NRCS office and work with them to review your contract's schedule. All required treatment must be installed at least 12 months before the end of the contract period.
3. Submit to NRCS an application for payment (Form NRCS-CPA-1245) when practice(s) are completed (CSP, Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentives Program (WHIP).
4. Submit receipts for practices completed. This is not required, but encouraged to assist NRCS in maintaining current cost data.
5. Permit free access for NRCS and/or its agents to provide technical assistance and to inspect the work at any reasonable time during the life span of the installed practices.

(Continued)

6. Forfeit all rights to further payments under the contract, refund to NRCS all contract payments received, and pay liquidated damages upon termination of the contract as outlined in the CPC Appendix.
7. Forfeit all rights to further payments under the CPC if the land under contract is transferred.
8. Upon cancellation of the contract, refund to NRCS all payments made under the contract as outlined in the CPC Appendix and as determined by specific program requirements.
9. Maintain the conservation treatment or practice installed on the land *for the life span of each practice*, as identified on the contract documents.
10. Share responsibility for ensuring that your conservation plan and contract documents are accurate and complete. The NRCS has no authority to compensate participants for practices and/or activities that are not in the contract at the time of obligation.
11. Ask questions! If you do not understand specific items or terms of the contract and its associated Appendix, let your local NRCS know. They will be happy to answer questions you may have.

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Other Online Resources:

GovDelivery **www.ga.nrcs.usda.gov**

Twitter: **@USDA_NRCS_GA**

YouTube **www.youtube.com/user/nrcsga**

USDA NRCS Natural Resources Conservation Service

Georgia NRCS

Entity Steps for: Applying for Conservation Programs Natural Resources Conservation Service (NRCS)

Your State NRCS Office is located at:

355 E. Hancock Avenue
Athens, Georgia 30601

Tel: Office: 706-546-2272
Fax: 855-417-8490

www.ga.nrcs.usda.gov

Helping People Help the Land

2013

ENTITY STEPS...

Entity – any partnership, joint venture, corporation (limited liability or other), estate, trust, non-profit association or group, or unit of state or local government that uses an employee identification number (EIN) or social security number (SSN) to apply for conservation program assistance.

1. **Applicant** indicates interest in a conservation program by signing appropriate program application forms.
2. **Applicant** establishes a customer record in the Service Center Information Management System (SCIMS). This will require the applicant set up an appointment with the Farm Service Agency (FSA) to complete record and necessary applicant eligibility information.
3. **Applicant** completes forms* to determine eligibility for USDA programs:
   - AD-1026 Highly Erodible Land and Wetland Conservation Certification
   - CCC-901 Members Information
   - CCC- 902E Farm Operating Plan for Payment Eligibility Review
   - CCC-931 Payment Eligibility Average Adjusted Gross Income (AGI)

These eligibility forms can be accessed on-line for your convenience. Please visit our eForms site at: http://forms.sc.egov.usda.gov/eForms/welcomeAction.do?Home

***The process of establishing applicant eligibility may take several weeks. Some forms may need to be updated annually. You must maintain eligibility status throughout the life of the conservation program contract in order to receive program benefits.**

(Continued)

4. **Applicant** sets up an appointment with local NRCS office to visit the operation and develop a current **conservation plan**. This process can take several visits—both in the office and in the field.
5. **NRCS** develops a program application package based on the approved conservation plan and discussions with the applicant.
6. **NRCS** reviews program applications and selects eligible applications for funding based on ranking criteria and available funding *when funding is available*. Because NRCS programs rely on funds being available, this step may occur weeks or months after your program application package is submitted.
7. **Applicant** provides additional information if NRCS determines their application *may be considered* for funding. This additional information includes:
   - Evidence that the business is in current good standing.
   - Business Documents** outlining
     1. Official business name
     2. The current members of the business
     3. The member(s) of the business who have legal authority to sign on behalf of the business

   ***** See "Typical Types of Business and Acceptable Evidence and Signature Authority" for more information***

   - Document from the IRS that indicates the **name** and **Employee Identification Number (EIN)** for the business. All applicants earning program benefits will receive IRS-1099's based on this information. If you do not have a form available, you may request one from the IRS:
   - Request a **Form LTR 147C** by calling IRS Customer Service @ 800-829-4933 or

     Department of the Treasury
     Internal Revenue Service
     Ogden, Utah 84201

   - Completed SF-1199 Direct Deposit Form. All program payments will be direct deposited using this banking information.

(Continued)

   - Power of Attorney Form (FSA 211 may be used) if the authorized individual wants to allow another individual to sign on their behalf.
8. **Applicant** must document control of the land for the contract period using any of the following:
   - Deed
   - Lease or
   - Other written authorization from the landowner ("NRCS—Farm Bill Conservation Programs Land Eligibility Certification Form" may be used)
   - Land must be considered an *eligible land use* for the program.

Failure to provide the required information may cause your application to be considered "ineligible" for the program year.

If your application is not considered for funding in the year you apply, your application may be considered in future years based on funding and meeting the requirements outlined above.

WHAT'S NEXT?

WHAT SHOULD I EXPECT NOW THAT I AM IN A CONSERVATION PROGRAM?

NRCS requires the participant adhere to the following once they enter into a Conservation Program Contract (CPC):

1. Start at least one practice in the contract within the first 12 months of the contract. **Note: Secure prior approval from NRCS before initiating construction on practices requiring an engineering design.**
2. Complete contract items as scheduled in the CPC. Contract items may be accomplished anytime prior to the year scheduled. (Exception: Conservation Stewardship Program (CSP) contract items do not have funds obligated to them ahead of schedule and therefore cannot be completed in advance.) If a practice will not be completed on schedule, you will need to contact your local NRCS office and work with them to review your contract's schedule. All required treatment must be installed at least 12 months before the end of the contract period.
3. Submit to NRCS an application for payment (Form NRCS-CPA-1245) when practice(s) are completed (CSP, Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentives Program (WHIP).
4. Submit receipts for practices completed. This is not required, but encouraged to assist NRCS in maintaining current cost data.
5. Permit free access for NRCS and/or its agents to provide technical assistance and to inspect the work at any reasonable time during the life span of the installed practices.

(Continued)

6. Forfeit all rights to further payments under the contract, refund to NRCS all contract payments received, and pay liquidated damages upon termination of the contract as outlined in the CPC Appendix.
7. Forfeit all rights to further payments under the CPC if the land under contract is transferred.
8. Upon cancellation of the contract, refund to NRCS all payments made under the contract as outlined in the CPC Appendix and as determined by specific program requirements.
9. Maintain the conservation treatment or practice installed on the land *for the life span of each practice*, as identified on the contract documents.
10. Share responsibility for ensuring that your conservation plan and contract documents are accurate and complete. The NRCS has no authority to compensate participants for practices and/or activities that are not in the contract at the time of obligation.
11. Ask questions! If you do not understand specific items or terms of the contract and its associated Appendix, let your local NRCS know. They will be happy to answer questions you may have.

USDA - Natural Resources Conservation Service

Other Online Resources:

GovDelivery **www.ga.nrcs.usda.gov**

Twitter: **@USDA_NRCS_GA**

YouTube **www.youtube.com/user/nrcsga**

USDA NRCS Natural Resources Conservation Service

Georgia NRCS

Individual Steps for: Applying for Conservation Programs Natural Resources Conservation Service (NRCS)

Your State NRCS Office is located at:

355 E. Hancock Avenue
Athens, GA 30601

Tel: Office: 706-546-2272
Fax: 855-417-8490

www.ga.nrcs.usda.gov

Helping People Help the Land

2013

INDIVIDUAL STEPS...

Individual – any individual who controls the enrolled land and uses their personal *social security number (SSN)* to apply for conservation program assistance.

1. **Applicant** indicates interest in a conservation program by signing appropriate program application forms.
2. **Applicant** establishes a customer record in the Service Center Information Management System (SCIMS). This will require the applicant set up an appointment with the Farm Service Agency (FSA) to complete record and necessary applicant eligibility information.
3. **Applicant** completes forms* to determine eligibility for USDA programs:
   - AD-1026 Highly Erodible Land and Wetland Conservation Certification
   - CCC- 902-I Farm Operating Plan for Payment Eligibility Review
   - CCC-931 Payment Eligibility Average Adjusted Gross Income (AGI)

These eligibility forms can be accessed on-line for your convenience. Please visit our eForms site at: http://forms.sc.egov.usda.gov/eForms/welcomeAction.do?Home

***The process of establishing applicant eligibility may take several weeks. Some forms may need to be updated annually. You must maintain eligibility status throughout the life of the conservation program contract in order to receive program benefits.**

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(Continued)

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   - Land must be considered an *eligible land use* for the program.

Water Troughs with Heavy Use Area

(Continued)

Failure to provide the required information may cause your application to be considered "ineligible" for the program year.

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Section 12

Good Grazing = Inc. Soil Moisture, Inc. Soil Health, and Lower Erosion

Michael Hall, NRCS Grassland Conservationist (Ret.)

Nathan Lowder, NRCS Soil Health Specialist

unlock the secrets in the soil basics & benefits

unlock the SECRETS IN THE SOIL

Healthy, fully functioning soil is balanced to provide an environment that sustains and nourishes plants, soil microbes and beneficial insects.

Managing for soil health is one of the most effective ways for farmers to increase crop productivity and profitability while improving the environment. Positive results are often realized within the first year, and last well into the future.

Soil Health

Soil is made up of air, water, decayed plant residue, organic matter from living and dead organisms, and minerals, such as sand, silt and clay. Increasing soil organic matter typically improves soil health since organic matter affects several critical soil functions. Healthy soils are also porous, which allows air and water to move freely through them. This balance ensures a suitable habitat for the myriad of soil organisms that support growing plants.

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Natural Resources Conservation Service

January 2013

It's not difficult to improve soil health. Here's how: till the soil as little as possible; grow as many different species of plants as possible through rotations and a diverse mixture of cover crops; keep living plants in the soil as long as possible with crops and cover crops; and keep the soil surface covered with residue year round.

Soil Health Benefits

Farmers who manage their land in ways that improve and sustain soil health benefit from optimized inputs, sustainable outputs and increased resiliency. Healthy soils benefit all producers – managers of large, row crop operations to people with small, organic vegetable gardens. Healthy soils provide financial benefits for farmers, ranchers and gardeners, and environmental benefits that affect everyone.

Healthy soils lead to:

- **Increased Production** – Healthy soils typically have more organic matter and soil organisms which improve soil structure, aeration, water retention, drainage and nutrient availability. Organic matter holds more nutrients in the soil until the plants need them.
- **Increased Profits** – Healthy soils may require fewer passes over fields because they are only minimally tilled and they aren't over-reliant upon excessive nutrient inputs to grow crops. Healthy soils can increase farmers' profit margins by reducing labor and expenses for fuel, and optimizing inputs.
- **Natural Resource Protection** – Healthy soils hold more available water. The soil's water-holding capacity reduces runoff that can cause flooding, and increases the availability of water to plants during droughts. Good infiltration and less need for fertilizers and pesticides keep nutrients and sediment from loading into lakes, rivers, and streams. Groundwater is also protected because there is less leaching from healthy soils. Additionally, fewer trips across fields with farm machinery mean fewer emissions and better air quality.

Soil Health Management Systems

Implementing Soil Health Management Systems can lead to increased organic matter, more soil organisms, reduced soil compaction and improved nutrient storage and cycling. As an added bonus, fully functioning, healthy soils absorb and retain more water, making them less susceptible to runoff and erosion. This means more water will be available for crops when they need it. Soil Health Management Systems allow farmers to improve profitability because they spend less on fuel and energy while benefiting from the higher crop yields resulting from improved soil conditions.

Contact your local NRCS office to learn more about Soil Health Management Systems and the technical and financial assistance available to help "Unlock the Secrets in the Soil."

unlock the SECRETS IN THE SOIL

unlock the SECRETS IN THE SOIL

Biodiversity increases the success of most agricultural systems.

Biodiversity helps to prevent disease and pest problems associated with monocultures. Using cover crops and increasing diversity within crop rotations improves soil health and soil function, reduces costs, and increases profitability. Diversity above ground improves diversity below ground, which helps create healthy productive soils.

Cover Crops

Cover crops can be an integral part of a cropping system. Cover crops can be managed to improve soil health, as they help to develop an environment that sustains and nourishes plants, soil microbes and beneficial insects.

Cover crops are typically planted in late summer or fall around harvest and before spring planting of the following year's crops. Examples of cover crops include rye, wheat, oats, clovers and other legumes, turnips, radishes, and triticale. Planting several cover crop species together in a mixture can increase their impact on soil health. Each cover crop provides its own set of benefits, so it's important to choose the right cover crop mixture to meet management goals.

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September 2012

Cover Crop Benefits

Restoring Soil Health – Cover crops help increase organic matter in the soil and improve overall soil health by adding living roots to the soil during more months of the year. Cover crops can improve water infiltration into the soil. Deep-rooted crops like forage radishes create natural water passages. Legume cover crops serve as natural fertilizers while grasses scavenge nutrients that are often lost after harvest or during winter.

Natural Resource Protection – Along with crop residue above ground, cover crops protect the soil against erosive heavy rains and strong winds. Cover crops trap excess nitrogen, keeping it from leaching into groundwater or running off into surface water – releasing it later to feed growing crops.

Livestock Feed – Cover crops can provide livestock producers with additional grazing or haying opportunities.

Wildlife Habitat – Cover crops provide winter food and cover for birds and other wildlife. During the growing season, they can provide food for pollinators.

Soil Health Management Systems

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Contact your local NRCS office to learn more about Soil Health Management Systems and the technical and financial assistance available to help "Unlock the Secrets in the Soil."

unlock the SECRETS IN THE SOIL

If soil health is your goal, till as little as possible.

Tillage can destroy soil organic matter and structure along with the habitat that soil organisms need. Tillage, especially during warmer months, reduces water infiltration, increases runoff and can make the soil less productive. Tillage disrupts the soil's natural biological cycles, damages the structure of the soil, and makes soil more susceptible to erosion.

Benefits of Reduced-Till/No-Till

Aiding in Plant Growth – Soils managed with reduced/no-till for several years contain more organic matter and moisture for plant use. Healthy soils cycle crop nutrients, support root growth, absorb water and sequester carbon more efficiently.

Reducing Soil Erosion – Soil that is covered year-round with crops, crop residue, grass or cover crops is much less susceptible to erosion from wind and water. For cropping systems, practices like no-till keep soil undisturbed from harvest to planting.

Saving Money – Farmers can save money on fuel and labor by decreasing tillage. Improving nutrient cycling allows farmers to potentially reduce the amount of supplemental nutrients required to maintain yields, further reducing input costs.

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Providing Wildlife Habitat – Crop residue, grass and cover crops provide food and escape for wildlife.

Production Inputs

Soils can be disturbed if inputs are not applied properly, potentially disrupting the delicate relationship between plants and soil organisms. Soil Health Management Systems help minimize that potential disturbance, while maximizing nutrient cycling, which can lead to greater profitability for producers.

Livestock Grazing

Improperly managed grazing can disturb the soil. There are several ways to graze livestock to reduce environmental impacts. For example, implementing a rotational grazing system instead of allowing livestock to continuously graze pasture allows pasture plants to rest and regrow.

Soil Health Management Systems

Implementing Soil Health Management Systems can lead to increased organic matter, more soil organisms, reduced soil compaction and improved nutrient storage and cycling. As an added bonus, fully functioning, healthy soils absorb and retain more water, making them less susceptible to runoff and erosion. This means more water will be available for crops when they need it.

Soil Health Management Systems allow farmers to enjoy profits over time because they spend less on fuel and energy while benefiting from the higher crop yields resulting from improved soil conditions. Healthy soils also provide a buffer for precipitation extremes (too wet or too dry).

Contact your local NRCS office to learn more about Soil Health Management Systems and the technical and financial assistance available to help "Unlock the Secrets in the Soil."

healthy, productive soils checklist for growers

unlock the SECRETS IN THE SOIL

Managing for soil health is one of the best ways farmers can increase crop productivity while improving the environment.

Results are often realized immediately and last well into the future. Following are four basic principles to improving the health of your soil.

1. Keep the soil covered as much as possible
2. Disturb the soil as little as possible
3. Keep plants growing throughout the year to feed the soil
4. Diversify as much as possible using crop rotation and cover crops

Use the checklist on the back of this page to determine if you're using core Soil Health Management System farming practices. It is important to note that not all practices are applicable to all crops. Some operations will benefit from just one soil health practice while others may require additional practices for maximum benefit. These core practices form the basis of a Soil Health Management System that can help you optimize your inputs, protect against drought, and increase production.

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June 2013

Soil Health Management Systems Include:

What is it?		What does it do?	How does it help?
Conservation Crop Rotation Growing a diverse number of crops in a planned sequence to increase soil organic matter and biodiversity in the soil.		• Increases nutrient cycling • Manages plant pests (weeds, insects, and diseases) • Reduces sheet, rill and wind erosion • Holds soil moisture • Adds diversity so soil microbes can thrive	• Improves nutrient use efficiency • Decreases use of pesticides • Improves water quality • Conserves water • Improves plant production
Cover Crop An un-harvested crop grown as part of planned rotation to provide conservation benefits to the soil.		• Increases soil organic matter • Prevents soil erosion • Conserves soil moisture • Increases nutrient cycling • Provides nitrogen for plant use • Suppresses weeds • Reduces compaction	• Improves crop production • Improves water quality • Conserves water • Improves nutrient use efficiency • Decreases use of pesticides • Improves water efficiency to crops
No Till A way of growing crops without disturbing the soil through tillage.		• Improves water holding capacity of soil • Increases organic matter • Reduces soil erosion • Reduces energy use • Decreases compaction	• Improves water efficiency • Conserves water • Improves crop production • Improves water quality • Saves renewable resources • Improves air quality • Increases productivity
Mulch Tillage Using tillage methods where the soil surface is disturbed but maintains a high level of crop residue on the surface.		• Reduces soil erosion from wind and rain • Increases soil moisture for plants • Reduces energy use • Increases soil organic matter	• Improves water quality • Conserves water • Saves renewable resources • Improves air quality • Improves crop production
Mulching Applying plant residues or other suitable materials to the soil surface to compensate for loss of residue due to excessive tillage.		• Reduces erosion from wind and rain • Moderates soil temperatures • Increases soil organic matter • Controls weeds • Conserves soil moisture • Reduces dust	• Improves water quality • Improves plant productivity • Increases crop production • Reduces pesticide usage • Conserves water • Improves air quality
Nutrient Management Managing soil nutrients to meet crop needs while minimizing the impact on the environment and the soil.		• Increases plant nutrient uptake • Improves the physical, chemical and biological properties of the soil • Budgets, supplies, and conserves nutrients for plant production • Reduces odors and nitrogen emissions	• Improves water quality • Improves plant production • Improves air quality
Pest Management Managing pests by following an ecological approach that promotes the growth of healthy plants with strong defenses, while increasing stress on pests and enhancing the habitat for beneficial organisms.		• Reduces pesticide risks to water quality • Reduces threat of chemicals entering the air • Decreases pesticide risk to pollinators and other beneficial organisms • Increases soil organic matter	• Improves water quality • Improves air quality • Increases plant pollination • Increases plant productivity

USDA United States Department of Agriculture

Natural Resouces Conservation Service

USDA

HEALTHY SOILS ARE: *covered all the time.*

Cover Saves Scarce Water

Extreme temperature changes and high winds characteristic of the semiarid, short-grass prairie of the the Great Plains can have drastic and devastating effects on exposed soil. In the High Plains sub-region of the Great Plains, more than 65 percent of the soil must remain covered to limit evaporation of water. Bare soil heats up quickly in direct sunlight; and the hotter it gets, the faster water evaporates from it.

In this rainfall-limited area (average annual rainfall is 10-20 inches), maintaining soil cover is a key to profitable agricultural production.

The combination of high winds and hot temperatures wastes water if soils aren't covered. However, ground cover (both living and residues) limits the drying effect of wind, shades the soil from hot sun, and traps snow during winter. All of which add up to more water infiltrating into the soil and less evaporating into the air.

unlock the SECRETS IN THE SOIL

IF YOU'RE TRYING TO MAKE YOUR SOIL HEALTHIER, YOU SHOULDN'T SEE IT VERY OFTEN.

In other words, soil should always be covered by growing plants, their residues, or a combination of the two. Keeping the soil covered all the time makes perfect sense when you realize that healthy soils are full of life and that the microorganisms living in the soil have the same needs as other living creatures. They need food and cover to survive.

When you have a vegetative cover on the soil, especially a living cover, you offer those microbes both food and shelter. Some scientists say when you till the soil and remove crop residues, the effects are as devastating to soil microbes as a combination of an earthquake, hurricane, tornado, and forest fire would be to humans. From the perspective of the living creatures within the soil, a tillage tool like a chisel shank has the effect of ripping the ground like an earthquake; removing residue is like a tornado ripping the roof off a house; uncovered soil can be drenched and whisked away by gushing water and wind like that of a hurricane—or scorched in the hot sun like an out-of-control fire.

STOP THE SPLASH, HARVEST THE BENEFITS

When a falling raindrop explodes as it hits bare soil, it dislodges unprotected soil particles, and begins the process of soil erosion. Cover crops and plant residue prevent that violent splash on soil, protecting soil aggregates from being pounded by falling raindrops.

Safe from disintegration by the hammering energy of raindrops, the structure of healthy soils remains intact, which prevents soil crusting. In this protective environment, water infiltrates the soil and becomes available to plant roots.

A mulch of crop residues or living plants on the soil surface also suppresses weeds early in the growing season, giving the primary crop a competitive

HEALTHY SOILS ARE: *covered all the time.*

advantage. This is especially the case if the cover crop is rolled prior to planting the main crop because the entire soil surface is covered and protected.

Cover crops can build moisture reserves far better than row crops can by themselves. Cover crops open pores and small channels in the soil for better water infiltration, and the organic matter they build helps retain both moisture and nutrients.

The cool, moist soil of cover crops also provides favorable habitat for many organisms that decompose residues and recycle nutrients for the next crop. Providing a good habitat for these organisms can increase residue decomposition, and improve nutrient cycling, by up to 25 percent.

LIVING PLANTS GO BEYOND COVER

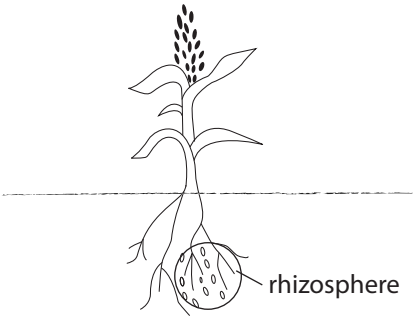
While it's easy to see the importance of giving the soil protection above the ground, it's not always as easy to recognize benefits living covers provide below the surface.

Through their roots, living plants offer soil microbes their easiest, most reliable food source. Because these soil microbes need a consistent food source throughout the year to thrive, cropping plans that include crop rotations with cover crops throughout the growing season (or perennial grasses and legumes) can help sustain them year-round.

WANT TO LEARN MORE?

VISIT WWW.NRCS.USDA.GOV

Living in the Rhizosphere



Every soil organism has something it eats…and something that eats it. Each organism and each bit of plant residue is important to the complex food web under the soil surface. While each source of microbial food is important to a balanced food web in a healthy soil, there is no better food for soil microbes than the sugars exuded by living roots.

Living plants maintain a rhizosphere, an area of concentrated microbial activity close to the root. The rhizosphere is the most active part of the soil biology because it is where the most easy-to-eat food is available for microbes. It's also critical for plant growth and health, because those microbes, in turn, provide essential nutrient cycling for crops.

Because living roots provide the easiest source of food for soil microbes, growing perennial crops or long-season cover crops is the key to feeding the foundational species of the soil food web—so they'll be healthy and ready to perform throughout the primary growing season.

USDA

HEALTHY SOILS ARE: *well-structured.*

Give it the Stake Test!

Does your soil have good structure? Give it the slake test! Ray Archuleta, an agronomist with the USDA Natural Resources Conservation Service with a passion for soil health, has done the test scores of times. Anyone can do it, he says, and he predicts it will open your eyes.

"What happens with poor soil structure is that the pores collapse in water and the soil breaks apart," Archuleta says. "Soil with good structure—the untilled soil—can still be intact for the most part even 24 hours later. The reason for the difference is soil structure. Biological cementing, the work of soil microbes, glues the aggregates of the untilled soils together."

In a similar test, an infiltration or rainfall simulation test, Archuleta puts the two soil samples in wire mesh inserted into empty jars, then simulates rainfall onto them.

"When you put a tilled soil and an un-tilled soil in yarn jars and simulate rainfall onto them, you quickly see the untilled soil allows the water to infiltrate the whole profile. On the other hand, water stays on top of the tilled soil much longer," Archuleta says.

Continued on back

unlock the SECRETS IN THE SOIL

"SOFT AND CRUMBLY." "LIKE COTTAGE CHEESE." "LIKE A SPONGE." "LOOSE AND FULL OF HOLES."

Those and other common descriptions of what healthy soil looks and feels like refer to good soil structure.

Soil structure, the arrangement of the solid parts of the soil and the pore space between them, is critical to how the soil functions. When the solid parts—sand, silt and clay particles—cling together as coarse, granular aggregates, the soil has a good balance of solid parts and pore space.

Highly aggregated soils—those granular, durable, distinct aggregates in the topsoil that leave large pore spaces between them—are soils with good tilth and good structure.

Well-structured soils have both macropores (large soil pores generally greater than 0.08 mm in diameter) and micropores (small soil pores with diameters less than 0.08 mm that are usually found within structural aggregates).

An interconnected network of pores associated with loosely packed, crumbly, highly aggregated soils allows rapid infiltration and easy movement of both water and air through the soil and provides habitat for soil organisms.

Chemical and physical factors play a prominent role in small aggregate formation in clay soils, while biological processes drive development of large aggregates and macropores. Earthworms, for instance, produce both new aggregates and pores. Their binding agents are responsible for the formation of water-stable, macro-aggregates, and their burrowing creates continuous pores linking surface to subsurface soil layers. As they feed, earthworms also speed plant residue decomposition, nutrient cycling, and redistribution of nutrients in the soil profile.

HEALTHY SOILS ARE: *covered all the time.*

Soil organic matter also helps develop stable soil aggregates. Soil microorganisms that are fed with organic matter secrete a gooey protein called glomalin, an effective short-term cementing agent for large aggregates. Organic glues are produced by fungi and bacteria as they decompose plant residues. Water-resistant substances produced by microorganisms, roots, and other organic matter, provide long-term aggregate stability from a few months to a few years.

TILAGE DESTROYS STRUCTURE

Management practices that reduce soil cover, disrupt continuous pore space, compact soil, or reduce soil organic matter, negatively impact soil structure. Since tillage negatively affects all of these properties, it's high on the list of practices damaging to healthy soils.

When tillage loosens the soil, it leaves soil particles exposed to the forces of wind and water. Transported by wind and water, detached soil particles settle into pores, causing surface sealing, compaction and reduced infiltration. When this happens less water is available to plants and runoff and erosion increases.

By contrast, soils that are not tilled and are covered with diverse, high residue crops throughout the year have better soil structure, are highly aggregated, with high levels of organic matter and microorganism activity, high water holding capacity, high infiltration rates, and little compaction.

WANT TO LEARN MORE?

VISIT WWW.NRCS.USDA.GOV

"I think these tests are powerful visual tools to help explain and help people remember how soils function" Archuleta continues. "I used to think if I tilled the soil—fluffed it up—it would allow more water in. But that's just not true. Tilling soil closes pore space and keeps rainfall from infiltrating. You've got to have pore space in your soil from top to bottom."

"The tests tell me in our watersheds we have an infiltration problem, not a runoff problem," he concludes. "What I mean is, if we focus on building healthy soils that result in more infiltration, we'll do what we need to do to eliminate much of the runoff."

How to do the Slake Test

The slake test compares two chunks of topsoil in water to see how well and how long they will hold together. Here are the steps:

1. Collect a chunk of topsoil—a size that would fit in your hand—from an area where you don't till, like a fencerow, or a field you've no-tilled or had in grass for many years.
2. Get a second spade-full or chunk of soil from a field you've tilled consistently. It should be the same soil type as the first sample.
3. Find two glass jars, yarn jars or some kind of clear glass jars large enough to hold the chunks of soil.
4. Put together some type of wire mesh that you can hook at the top of each jar that will allow the soil to be submerged in the water, yet be held within the top half of the jar.
5. Insert the wire meshes into each jar.
6. Fill the jars with water.
7. At the same time, submerge the tilled sample in one jar, and the untilled sample in the other.
8. Watch to see which soil holds together and which one falls apart. The soil with poor structure is the one that will begin to fall apart.

If you want to see "Ray the Soil Guy" demonstrate the test or the infiltration test, checkout our online resources.

Section 13

Choosing the Right Fence, Fence Charger, and Wire or Tape for Your Grazing System

Dr. John Worley, UGA

2016 Georgia Grazing School:

Choosing the right fence, fence charger, and wire or tape for your grazing system

Dr. John Worley
Professor

Choosing the Right Fence, Charger, and Wire or Tape for Your Grazing System

2016 Georgia Grazing School

John W. Worley

UGA extension

Fencing Systems

- Plan the system before building
- Choose the right materials
- Use the right construction techniques
- Perimeter Fence vs. Cross Fencing

Types of Fences

- Field Fence (Page wire, hog wire, woven wire) w/ barbed wire at top
  - Perimeter and baby calf areas and near busy roads

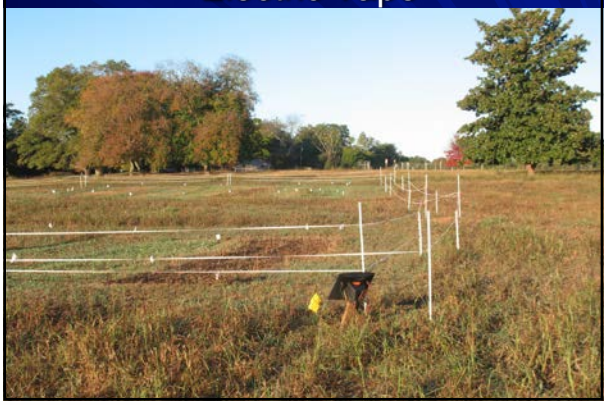
Types of Fences

- Barbed wire
  - Where electric doesn't work well
    - Swampy, heavily vegetated areas

Types of Fences

- Electric (Note vinyl coated wire)

Electric Tape



GRASS www.georgiaforages.com

Grazing School

UGA extension

THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

2016 Georgia Grazing School:

Choosing the right fence, fence charger, and wire or tape for your grazing system

Dr. John Worley
Professor

Wire vs Tape

Wire Types

- Steel (Low Carbon vs **High Tensile**)
  - Single, barbed, woven
- Galvanizing (Class I or **Class III**)
- Vinyl Coated (including conductive)
- Electric Tapes and Ropes
  - Temporary
  - Permanent

Post Types

- Wood
  - **Treated (at least 0.4 lb/ft^3) Ground Contact**
  - **CCA is preferred**
  - Untreated (Landscape Timbers are untreated or lightly treated)
- Steel (Painted or Galvanized)
- Plastic (Temporary electric)
- Fiberglass
  - Sucker Rod (High Density FG)

Materials

- Perimeter Fencing
  - Recommend High Tensile, Class III galvanized wire
  - Galvanized Steel or Treated Wood Posts
  - Class III galv. staples (1 ¾")
- Cross Fencing
  - If truly temporary, use plastic posts and electric rope or tape

Components with Similar Lives

- Painted Posts with Class III galvanized wire

How Long Will It Last?

- Painted Posts with Class III galvanized wire

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Professor

How Long Will It Last?

- Galvanized Posts with Class I galvanized wire

How Long Will It Last?

- Galvanized Posts with Class I galvanized wire

How Long Will It Last?

- Painted Posts, Class I woven wire, Class III barbed wire

Fence Chargers
(Controllers, Energizers)

- Look for Low-Impedance charger
- Look for ratings at different loads (ohms)
  - 50,000 ohms (fence in good condition)
  - 5,000 ohms
  - 500 ohms
  - 100 ohms (fence in poor condition)
- At least 1000 volts @100 ohms

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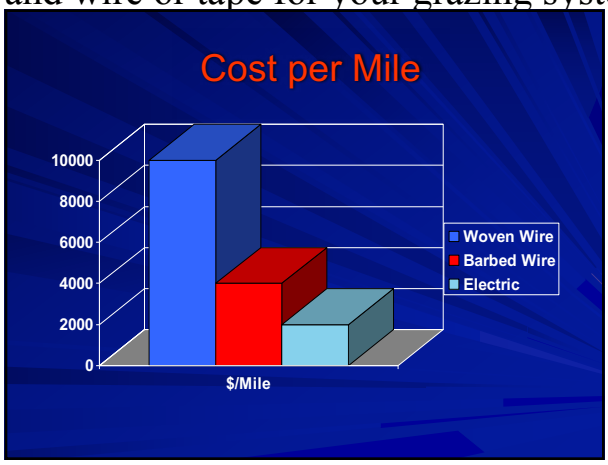

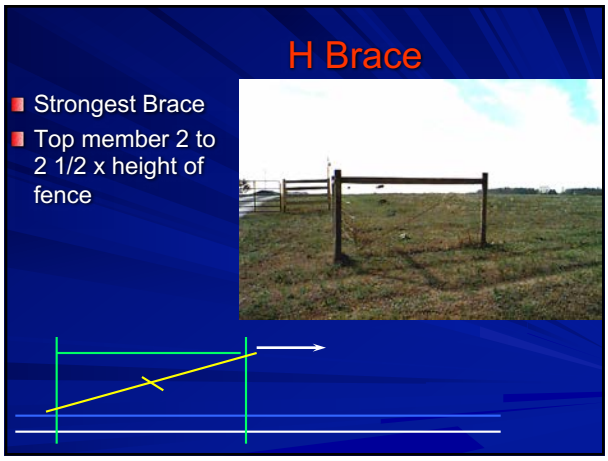

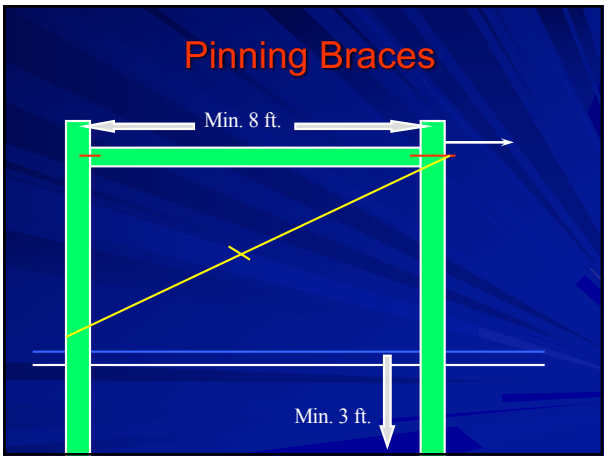

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Nailed Braces

- Not Recommended

Nailed Braces

- Not Recommended

Installing Brace Wire

- Tensioning the wire brace

Pass-thru Line Brace

- Not recommended

Photo courtesy of NRCS

Line Brace

- Wire Wrapped Around Post

Correct Line Brace

- Each end wrapped around center post
- Can go 660 ft between braces if terrain allows and properly constructed.

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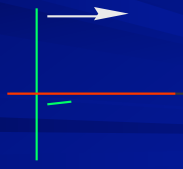
Dead-Man Brace

- Need Larger Post
- Not as Strong
- Easier to Build



Stapling Technique

- Leave Wire Loose
- Only Horizontal Wires
- Rotate from Vertical (Rotate away from slashes)
  - Right for right-handed staples
  - Left for left-handed
- 1 3/4" Galvanized Staples

Post Installation

- Driven wooden posts are stronger
- Drive Small End Down

Post Installation

- Proper Tamping Procedure

Electric Fence Grounding

- Proper grounding of charger is vital
  - 3 or more 8-ft rods
  - 10 ft apart
  - Separate from other electrical grounds
  - Drive and connect all rods
  - Never Concrete Over
- Ground Alternate Wires

Lightning Protection

- Good grounding is essential
- Nothing is "Lightning Proof"
- Use devices sold by charger manufacturer to maintain warranty

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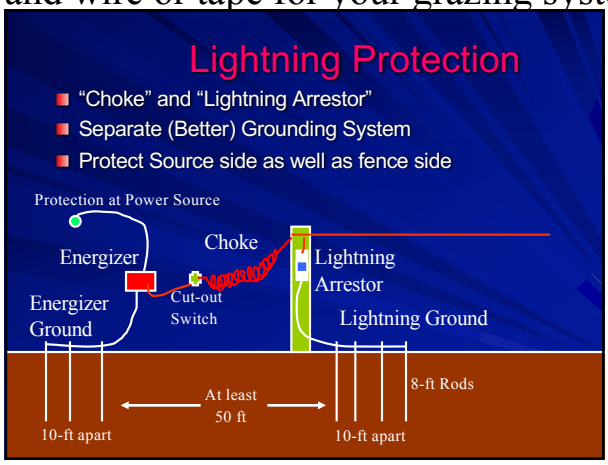


Fencing Options for Grazing Systems

John W Worley

One of the challenges of establishing a grazing system is building a fencing system that allows you to easily rotate cows from one grazing site to another. Ideally, this fencing system will be inexpensive, easy to build, and easy to maintain. In reality we sometimes have to sacrifice one or more of these goals to achieve another. Sometimes, for instance, it is better to put a little more into a fence to start with in order to lower long-term maintenance. Many times, "temporary" fences become permanent fences with high maintenance requirements. This presentation will attempt to give some pointers on choices of building materials, equipment, and construction methods that will reduce the overall cost of fencing systems.

Types of Fences

Rotational grazing fences usually fall into one of the following categories:

1) Field fence (also known as woven wire, page wire, or hog wire) – Excellent holding power with low maintenance, but high initial cost. Usually used for perimeter fencing.
2) Barbed wire – Lower cost (about half that of field fence), good holding ability as long as tension is maintained. Also good where vegetation tends to interfere with electric fencing.
3) Electric
    a) Permanent – about half the cost of barbed wire, excellent holding power with good maintenance. Vegetation control and monitoring are necessary.
    b) Temporary – Low cost, fast installation. Cost may be higher per foot than permanent because of higher priced materials, but flexibility is improved. This is especially beneficial for temporary cross fencing.

Wire

One of the most significant innovations in fencing has been the introduction of high-tensile, Class III galvanized steel wire. "High-tensile" means that the steel is much stronger than standard steel. The cost is usually less than standard steel wire because of the smaller wire size, yet the smaller wire is stronger than the larger standard steel wire. Perhaps more important than the cost difference is the fact that high-tensile steel wire is much more likely to stretch under stress (cows pushing against it, trees falling on it) and then return to its original length than is standard steel wire, which tends to stretch and stay stretched. As a result, **if the fence brace assemblies are adequate**, line posts can be spaced much farther apart (20 to 25 ft) than posts in standard wire fences (10 to 12 ft). Many people have reported cutting fallen trees off of high-tensile wire fences and watching the fence spring back to its original position with little or no repair work necessary.

Class III galvanizing is simply an extra thick coating of zinc on the wire. This typically gives the wire about twice the life that it would have with standard (Class I) galvanizing.

High-tensile, Class III galvanized wire is available in single wires (electric fencing), barbed wire, and field fence. There is one drawback to this type of fence wire. Since it is a harder, stronger wire, it is also harder to work with than standard steel wire. It is hard to bend, tends to break if you bend it too sharply, and is hard to cut. You need a cutting tool designed to cut this steel wire, else the cutting blades will be quickly dulled. If you have a pair of wire cutters designed for high-tensile steel wire, you must be careful not to twist the cutters or use them for pulling laterally since the cutting edges are very hard and therefore brittle, and they will break rather than bend. Once you learn how to work with high-tensile steel wire and have the right tools, I think you will find that its advantages (lower cost, longer life, resiliency, fewer line posts) outweigh its disadvantages.

For temporary fences, conductive ropes or tapes are generally recommended because they are very flexible and easy to roll up, move, and reinstall. Ropes seem to last longer than tapes, but tapes are more visible which is important when cattle encounter a fence where they are not accustomed to seeing it. Vinyl coated wire is another useful option on permanent electric fencing because it adds to the visibility of the fence. Vinyl coating is available in a conductive form so that the electric wire is still effective at shocking.

Posts

Traditionally, treated wood posts have been the most commonly used fence posts. Posts should be labeled for ground contact, which means they have enough chemical added to prevent rot when in contact with the ground.

Steel posts are another popular option, and the relative market price of steel vs. wood determines which is the best buy. One of the biggest problems with steel posts is that they are commonly painted rather than galvanized. A painted post will begin rusting in a very few years, resulting in rusting and early failure of the wire. A wire that should last 30 to 40 years may have its life cut in half by rust from non-galvanized metal posts, not to mention the degradation of fence appearance. If possible, I would obtain Class III galvanized posts so that you can take advantage of the full, expected life of the Class III galvanized wire. If wooden posts are used, use Class III galvanized staples for the same reasons.

High-density fiberglass posts are another good choice for electric fencing since they do not require insulators, have a long life, and are very strong. These posts are made from “sucker rod”, a byproduct of the oil industry, and are sometimes readily available, and sometimes hard to find. Their cost is similar to a wooden line post. These posts should be handled with gloves, especially after they are exposed to the weather for a few months because they are made of fiberglass, and the glass fibers will easily penetrate the skin.

For temporary fencing, there are a number of plastic and fiberglass “tread-in” posts available as well as small metal posts with insulators. These posts typically don’t have much lateral strength, but for electric fences, as long as the fence is straight and properly energized, that doesn’t usually present much of a problem.

Chargers

For electric fences, one of the most expensive **and most important** components is the fence charger (also known as the energizer or controller). Probably the most important factor to look for in a charger is how well it holds up when the fence gets in poor repair (vegetation touching the fence, spider webs, broken insulators, etc.) ASABE (American Society of Agricultural and Biological Engineers) has established a standard for testing fence chargers. Basically, the voltage and the energy output (in Joules per pulse) are measured with the following resistors placed between the fence terminal and the ground terminal.

50,000 ohms (represents a fence in excellent condition)
5,000 ohms
500 ohms
100 ohms (represents a fence in very poor condition)

I would encourage you to look for a controller that has been tested by this standard and maintains a high voltage (at least 1,000 volts) under the extreme conditions of a 100-ohm resistor. This will assure you a strong charge even when the fence is compromised by vegetation and other maintenance factors.

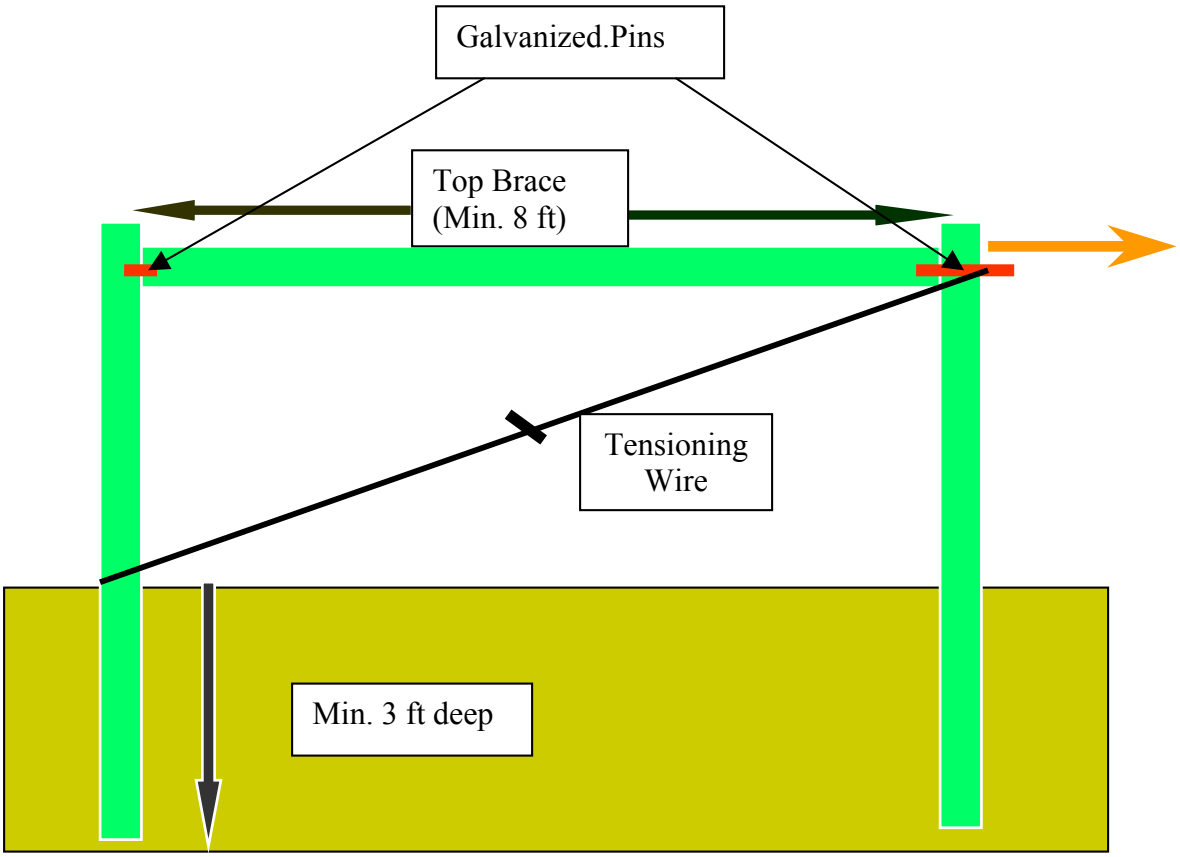
Construction

Building a fence is somewhat like building a house or a barn. Each component plays an important part in the success of the structure, but the one component that everything else depends on is the foundation. Without a good foundation, a building will lose its integrity regardless of how the rest of the structure is built, and the same is true of a fence. The foundation of a fence is the brace assemblies. Each section of fence is basically two brace assemblies with wire stretched between them and line posts to help keep the wires in the right position. Line posts are used to guide the wires along gentle curves, up and down over rolling terrain, and to keep the wires spaced properly. More line posts are needed for standard steel wire than for high tensile wire because standard steel will not recover its original shape as well and thus tends to sag more. High tensile steel will sag as well due to seasonal temperature differences, but if properly installed, can be retensioned easily.

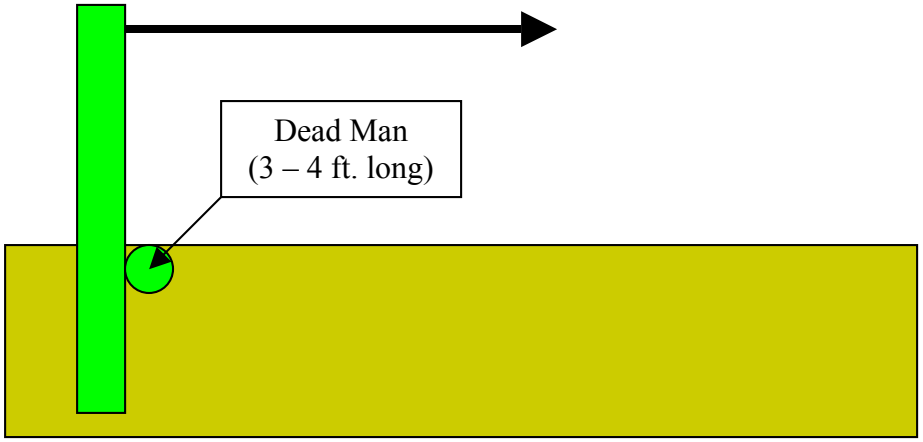
There are two common types of brace assemblies – the H-Brace and the Dead Man.

H-Brace: The H-Brace (shown below) works by transferring the load from the top of the corner post to the bottom through the horizontal brace post and the tensioning wire. There are two keys to making the H-brace work to its maximum advantage that are often overlooked.

1. The top (horizontal) brace post must be held in place. Over time, the ground tends to shift and cause the post to move so that it no longer supports the brace. The best way to accomplish this is to use small (1/2") galvanized pins as shown in the figure below. "Toenailing" with nails will not hold as well as this method.
2. The tensioning wire must be installed at a low angle with the ground. Otherwise, the wire will try to pull the corner post out of the ground when it is tightened. To assure the proper angle, the top brace post should be 8 to 10 feet long (for a 4-ft. high fence).



Dead Man Brace: The "dead man brace" uses a short post about 3 to 4 ft. long buried in the ground at the bottom of the corner post and perpendicular to the post and the fence (see illustration below.) The strength of this brace comes from the fact that the corner post must push the "dead man" through the soil in order to move in the direction of the fence pull. If a large corner post is used, this is a fairly effective brace, especially for short runs of a few hundred feet, and is cheaper and easier to build than the H-brace. For longer runs (up to a quarter mile), I would recommend using the H-brace.



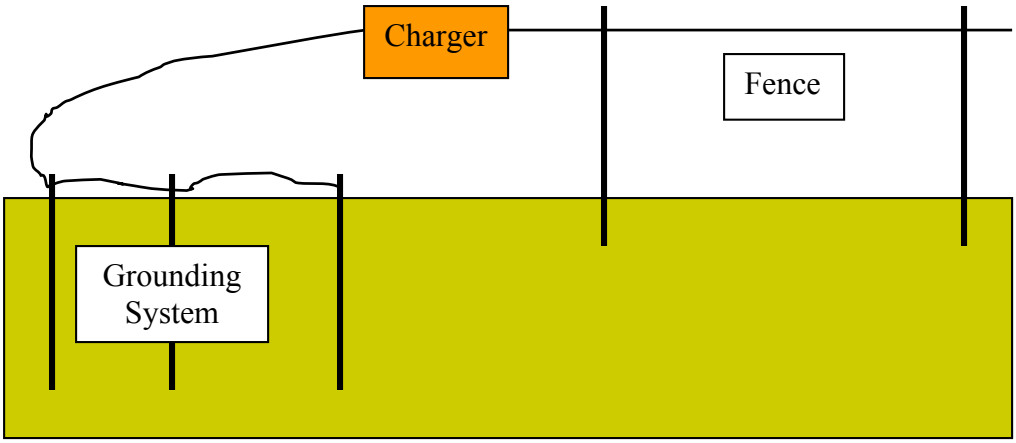
Post Installation: Wooden posts can be installed either by digging a whole and tamping dirt around the post or by driving it into the ground with a post driver. Driven posts tend to be stronger. If driven, the posts should be driven with the small end down. If tamped, it is important to put a small amount of dirt into the hole, tamp it, and then put more dirt in. You can't fill the hole up and then tamp it or it will not hold. Metal and fiberglass posts are best driven into the ground by hand or with a power post driver.

Staples: Again, I would recommend using Class III galvanized staples, and they should be 1 ¾" long if used in soft (pine) wood. Here are a few important tips to remember about the proper installation of staples.

1. Staples should be driven into line posts in such a way as to allow the wires to move under the staples. This allows the wire to move on impact or when heated or cooled by the weather, and then return to its original position. Staples should only be driven tightly on brace post assemblies.
2. Only horizontal wires should be stapled.
3. Staples should be installed with a slight rotation from vertical. Installing a staple vertically (parallel to the post) tends to encourage splitting of the wood. It is important that you rotate the staple in the right direction in order to cause the ends of the staple to spread out and greatly increase the holding power of the staple. There are two types of staples on the market, commonly referred to as right-handed and left-handed staples. Put the staple in your hand with the points aiming away from your body. If there is a slash (flat area) visible on the right-

hand point, it is a right-handed staple. Rotate it slightly to the right (clockwise) before driving. If the slash is visible on the left-hand side, rotate it to the left.

Fence Charger Installation: One of the most important things to remember about installing a fence charger is getting a **good grounding system**. Current can only flow through a complete circuit, and the completion of the electric circuit depends on getting current back through the ground to the grounding system and thus back to the charger. The better the grounding system is, the easier it is for the charger to accomplish this task. Follow the charger recommendations, but usually they recommend installing at least 3 8-ft copper-clad ground rods at least 10 ft apart and connected together with heavy (#6 or #8 copper) wire. This grounding system should be completely separate from any other farm grounding system to minimize the chance of getting stray voltage onto the farm electrical systems.

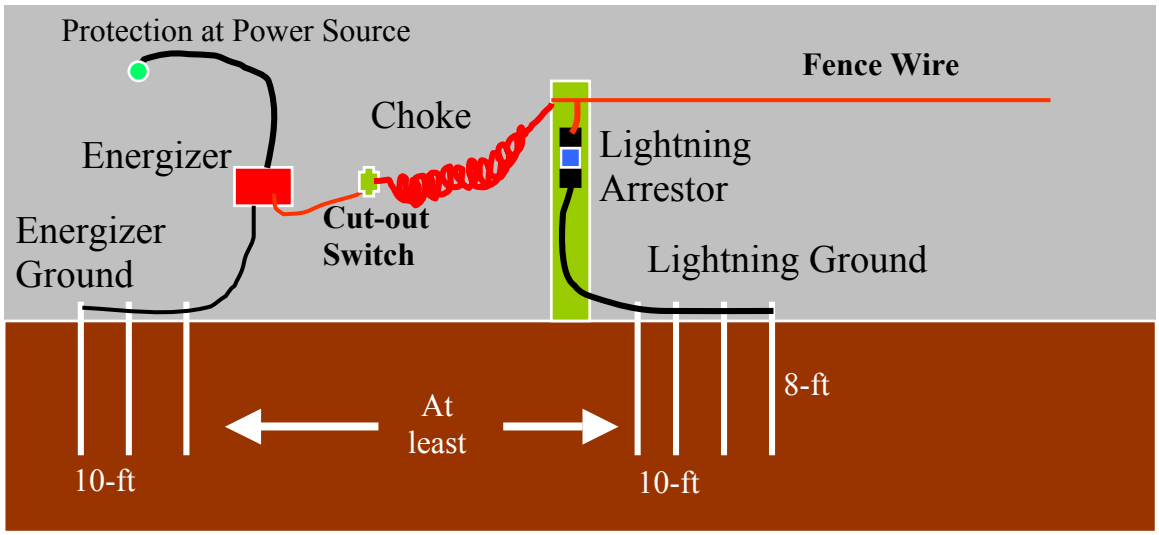


Another strategy that can help, especially in times of drought, is to **ground every other wire (connect them directly to the ground of the charger**.) When the ground is dry, it makes a poor conductor, and it is hard to get current to pass through cows and the dry ground and get back to the charger. If every other wire is a ground wire, then the cow only has to touch two wires, and the current will pass from the hot wire through the cow to the ground wire.

Lightning Protection: Another important issue for any fence, but especially for electric fences is lightning protection. Lightning will always find a path to ground, and it usually will find a number of paths. The goal is to get lightning to the ground through a path that will not cause harm to cattle or equipment. Here are a few things to remember about lightning protection:

1. Nothing is lightning proof! If it hits directly enough, it will destroy almost anything.
2. I recommend using lightning protection supplied by the fence charger manufacturer to protect the charger. That makes it more likely that their warranty will be honored (if they have a warranty against lightning damage).

3. It is a good idea to ground the fence about every ¼ mile by driving a ground rod and attaching it electrically to any grounded wires in the fence. This will provide multiple paths to ground for the lightning. Obviously, if you use metal posts, this would be unnecessary.
4. The figure below shows some guidelines for a good lightning protection system.



Summary

Desirable qualities of a fence are resiliency (springs back after being hit or stretched), high visibility, economy, and ease of installation. If you plan carefully, use the right materials, and put a little extra effort into the installation, your fence should be a good investment that will require a minimum of maintenance and will help make your rotational grazing system a success.

Section 14

Selecting the Right Watering System and Sizing the Water Supply for Your Grazing System

Dr. John Worley, UGA

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Selecting the right watering system and sizing the water supply for your grazing system

Dr. John Worley
Professor

Watering Options for Your Grazing System

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Watering Systems

- Provide water in all locations
- Provide adequate watering space
- Provide adequate flow and pressure
- Remember safety and sanitation

Picture Courtesy of NRCS

"The Creek"

- Fencing across a creek is always a challenge
- Damage to creek banks impair water quality
- "Not enough creeks to go around" for rotational grazing systems

Mechanical Watering Systems

- Advantages
  - Put the water where you want it
  - Improve water quality (for the cows and the down-stream neighbors)

Picture Courtesy of NRCS

Mechanical Watering Systems

- Disadvantages
  - Cost (especially for multiple units)
  - Availability of power for pumping
  - Mud around waterers

Picture Courtesy of NRCS

Reduce # of Required Waterers

- Place Waterer across fence to provide access from both sides

Picture Courtesy of NRCS

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Professor

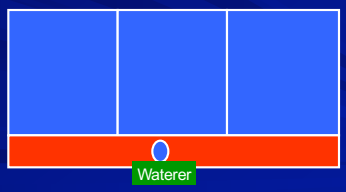
Reduce # of Required Waterers

- Make sure adequate space is available from either side
  - One bowl for each 15 cows
  - One ft of space for each 10 cows

Pictures Courtesy of NRCS

Reduce # of Required Waterers

- Place waterer in an area accessible to more than one paddock
- Could be a lane or a working pen



Power in Remote Areas

- Solar Power
  - Best for surface or shallow well
  - Provide extra storage for nights and cloudy days

Pictures Courtesy of NRCS

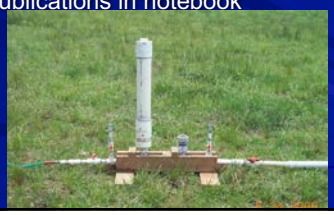
Power in Remote Areas

- Solar Power
  - Provide extra storage for nights and cloudy days
  - 12 gal/day x 2 to 3 days x # of cows
  - Can be in storage tank or watering trough

Pictures Courtesy of NRCS

Power in Remote Areas

- Ram Pumps
  - Another alternative where flowing water is present nearby
  - Works on the momentum of flowing water
  - See Publications in notebook



Mud Around Waterers

Picture Courtesy of NRCS

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Mud Around Waterers

- Siting
  - **High well-drained area**
- **Maintenance**
  - Check Valves regularly
- Heavy Use Areas
- NRCS FOTG
  - HUA Code 561
  - Watering Fac. Code 614
- (See Univ. of KY pub in notebook)

Picture Courtesy of NRCS

Mud Around Waterers

- Heavy Use Areas
  - Originally used to stabilize dirt roads
  - Roughly half the cost of concrete
  - Concrete "moves mud to edge of concrete"

Picture Courtesy of NRCS

Heavy Use Area

- Geotech Fabric – stabilizes foundation
- Coarse aggregate 4-6" No. 3 or 4 gravel
- Fine aggregate 2-3"
  - "crusher run"
  - "dense grade"
  - Sand
  - crushed limestone
  - fly ash? Other materials?
- Make sure edges of fabric are buried
- Pack Mechanically

Heavy Use Area

- Watering area
  - At least 15 ft from watering trough for cattle
  - 8 ft for sheep and goats
- Travel Lanes
  - 8 to 15 ft wide
  - Fence to force use
  - Crown the center of lanes for drainage
  - Avoid use by vehicles except for scraping and maintenance

Drinker Types

- Troughs (Concrete, Galvanized Steel, others)
  - More access space
  - Usually lower cost
  - More storage in the drinker

Pictures Courtesy of NRCS

Drinker Types

- Individual Drinker
  - Fresher, cleaner water
  - Some are "freeze proof"
  - Less storage in the drinker

Pictures Courtesy of NRCS

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Professor

Control Valve

- Can be under water for freeze protection
- Must be siphon proof
- Must have min. pressure to operate properly

Pictures Courtesy of NRCS

Sizing the supply system

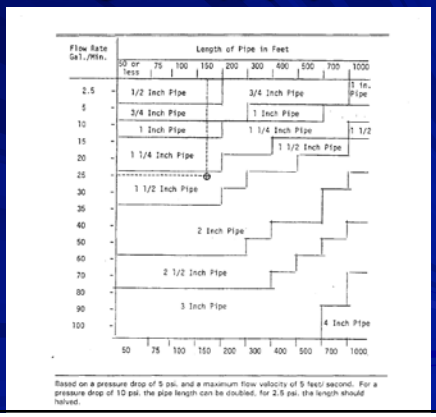
- Need to pump daily need in 4 hours
- 18 gal/day/cow x 100 cows = 1800 gpd
- 1800/4 hrs = 450gph = 7.5 gpm @ operating head (resistance)
- Can reduce pumping rate by increasing storage (especially useful in solar systems)

Picture Courtesy of NRCS

Sizing the supply system

- Pump – operate efficiently at flow rate and pressure expected
- Pressure Head
  - Elevation Change
    - Water level in well or pond
    - Elevation of drinker or top of storage tank
    - (10 ft = approx. 4.3 psi)
  - Speed of water in pipe
  - Length of pipe
- Limit friction drop to 5 psi
  - Most home systems operate at approx. 40 psi
  - Drinkers need at least 5-10 psi

Sizing the supply system



Sanitation

- Anti-siphoning valves should always be used on livestock waterers to prevent contaminated water from returning to well when pressure is lost.
- Drinkers should be easy to drain and clean

QUESTIONS ?

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Watering Options for Grazing Systems

Dr. John W Worley

One of the challenges of designing a grazing system is providing an abundant supply of clean drinking water to cattle that are located in multiple areas (paddocks or pastures.) The use of surface water (creeks) has multiple drawbacks. Fencing across a creek is always a challenge because of storm flows damaging the fence, and the fence preventing debris from flowing down the creek. Also, cattle tend to degrade the banks of the creek increasing sediment loading and decreasing water quality.

Mechanical watering systems have many advantages, but also present some challenges of their own. 1. They cost money to install and operate. 2. Many times, there is no electricity available for pumping at remote locations. 3. Multiple pastures or paddocks mean multiple waterers that are not fully utilized when the cows are in a different paddock. 4. Cows tend to congregate around waterers, the waterers tend often leak, and cows spill water, all of which leads to a muddy area around many waterers. Some of these challenges can be addressed and costs minimized by proper planning. This document will describe some of the strategies that have been used to overcome these potential obstacles.

Reducing the number of waterers required

Placing a waterer through a fence enables one waterer to be used from two paddocks. (See Figure 1.)

Figure 1: Waterer between two paddocks.

Care must be exercised to provide enough watering space for cows from each side of the fence, however. For waterers where only one cow can drink at a time, it is recommended to have at least **one cup or bowl for each 15 cows**. (Beef Housing and Equipment Handbook) For a drinking tank, it is recommended to provide **one foot** of accessible tank perimeter **per 10 cows**. That means one ft/10 head on each side of the fence for a split installation. Cows tend to drink as a group, so adequate access to the waterers is important.

Another option for reducing the number of waterers required is to place a waterer in a lane or a common area that can be shared by a number of paddocks. A waterer can also be placed in a working pen that can be accessed from a number of paddocks. This not only provides a common watering site, but accustoms the cows to going into the working pen. Care must be exercised to not allow the working pens to become too muddy however.

Availability of Power

If electricity is unavailable at a remote site, water can be pumped by solar power or a ram pump. (For more information on ram pumps, see http://www.caes.uga.edu/departments/bae/extension/pubs/documents/rampump3.pdf
and
http://www.caes.uga.edu/departments/bae/extension/pubs/documents/homeram.pdf
Solar energy can be used to pump water, and in some cases, may be the most economical choice.

In general, solar pumps are most efficient when pumping from surface water or shallow ground water (less than 50 ft deep.) Pumping from deep ground water requires more energy and considerably more investment in solar panels. Due to the intermittent availability of solar power (nights and cloudy days) a solar powered watering system requires considerable reserve storage, either in the waterer itself or in a tank that feeds the waterers. Another alternative is to have backup batteries that store solar power for use during those times when solar is not available. The batteries and required sensing and switching mechanism for this system are usually more expensive than providing extra water storage. I would recommend 2 to 3 days of storage capacity. A typical 1,000 lb cow would drink up to 18 gallons of water per day in hot weather, but on rainy or cloudy days, would drink considerably less, so I would use a figure of 12 gallons/head/day. This

reserve storage could be in the drinkers, the tank, or a combination of the two.

Stream crossings are still an option for livestock watering, although they have the drawbacks mentioned above, and precautions should be used.

Mud around waterers

"Heavy Use Areas" can be installed around waterers to minimize mud problems. An excellent publication on these surfaces is available from the University of Kentucky at: (http://www.ca.uky.edu/agc/pubs/aen/aen79/aen79.pdf) The idea originated in the road construction industry for stabilizing dirt roads. The principle of heavy use area construction is to stabilize the soil underneath the top layer so that it does not move, settle, and form mud holes.

Figure 2: Prefabricated Concrete Watering Tank on Heavy Use Area

Basically by putting down a layer of geotech fabric, the rock placed on top of the fabric cannot move from side to side, and thus depressions are prevented from forming. Typically this type of construction costs about ½ that of a concrete pad. When choosing the site for waterers, it is wise to choose a site that is high and well drained. In addition, regular checking and maintenance of valves and pipes is important in preventing excess mud as well as wasted water.

Choice of Drinker Type

Individual drinkers like the one shown in Figure 1 have the advantage that they help keep the water cooler and cleaner in hot weather and that they are virtually freeze proof in cold weather. Tank waterers (Figure 2) which can be made of galvanized steel, plastic, or concrete; have the advantage of greater accessibility to a number of animals and more water storage in the waterer itself. Individual waterers must have water provided to them at all times because the water would be quickly depleted if the supply were cut off. That is especially a consideration when solar pumps are used to supply the waterers.

Note that the concrete waterer in Figure 2 has the control valve mounted in the bottom middle of the tank. That protects it from both mechanical damage (cows rubbing against it or running into it) and freezing and eliminates many of the maintenance problems associated with top mounted valves.

Sizing the Supply System

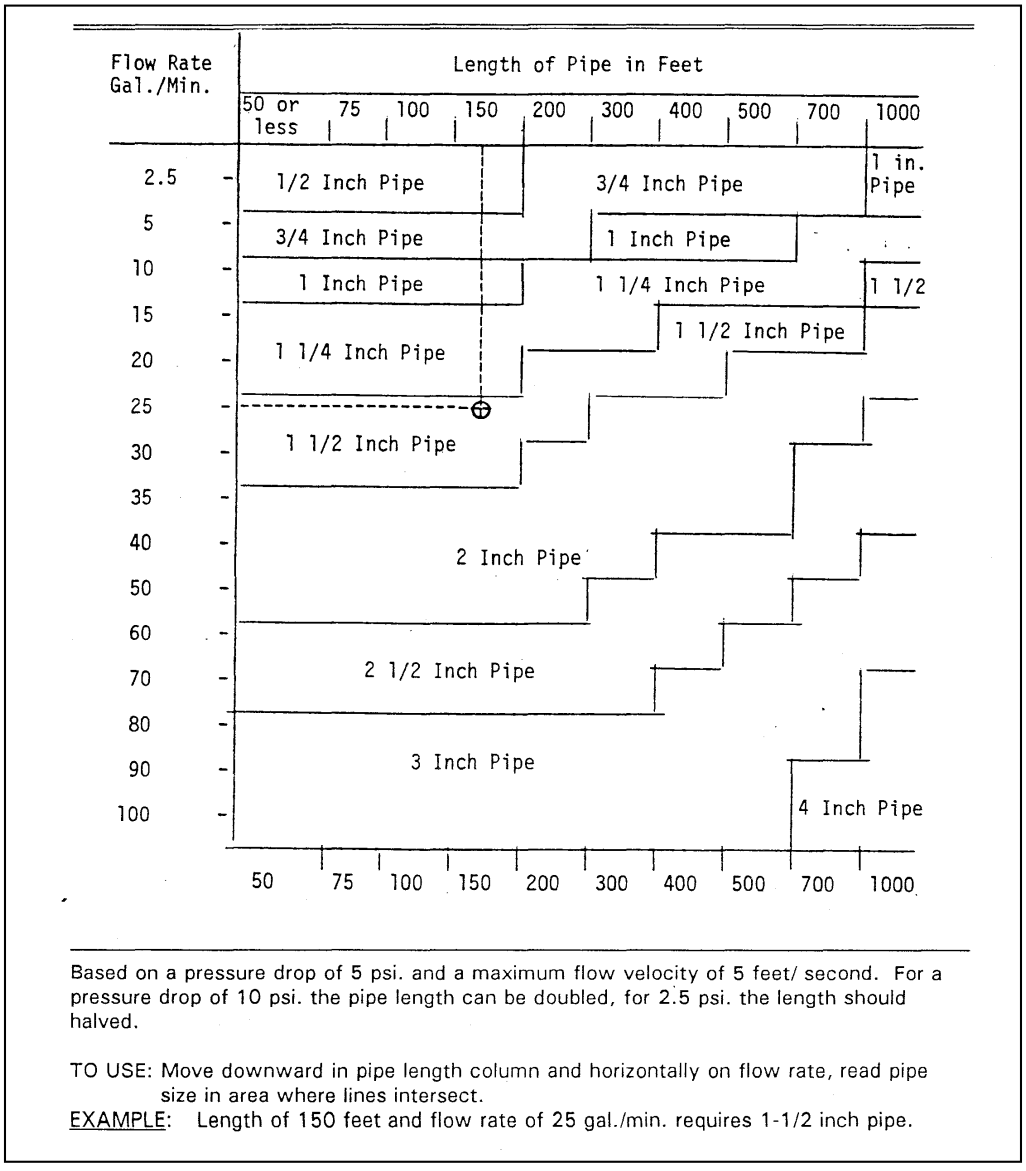
Whether using solar or conventional electric power to pump water, it is important to size the pump and pipe to deliver the maximum needed flow of water without excessive friction loss in the pipe. Three things potentially contribute to pressure drop in water pipes, the length of the pipe, the flow rate of water, and the elevation change from one end to the other. If we try to force too much water through a small pipe, friction loss will reduce the pressure at the waterer reducing the flow rate and sometimes causing the valve not to operate properly. The supply system should be able to pump water for a day in about 4 hours since cows tend to drink as a herd. With a maximum rate of 18 gal/day, 100 cows would need 1800 gallons of water. To pump that in 4 hours, the flow rate would be 7.5 gal/min.

Figure 3 may be helpful in sizing the pipe needed to supply the waterer(s). In the above example, if the flow rate is 10 gal/min, and the watering site is 300 ft from the pump, a 1 ¼ inch pvc pipe would be needed to limit the pressure drop to 5 psi. If sufficient pressure exists to allow 10 psi pressure drop, a 1 inch pipe would suffice. Generally, most home water systems operate around 40 psi, and the drinker valve should have at least 10 psi of pressure at all times. Also, remember that if you are pumping up hill, you will lose pressure as well. For every 10 ft of elevation, the pressure drops (or increases if going down hill) by approximately 4.3 psi. The pump needs to be sized to deliver the needed flow rate at the total pressure it will be working against, including elevation from the water level (bottom of the

well or surface of a pond), friction loss in the pipe, and the operating pressure in the system.

Sanitation

Waterer control valves should always be fitted with anti-siphoning devices. This prevents contaminated water from being sucked from the trough down into the well or water source when the pump shuts off.



Based on a pressure drop of 5 psi. and a maximum flow velocity of 5 feet/ second. For a pressure drop of 10 psi. the pipe length can be doubled, for 2.5 psi. the length should halved.

TO USE: Move downward in pipe length column and horizontally on flow rate, read pipe size in area where lines intersect.
EXAMPLE: Length of 150 feet and flow rate of 25 gal./min. requires 1-1/2 inch pipe.

Figure 3: Recommended Size for PVC or Plastic Pipe

References:

Beef Housing and Equipment Handbook, Fourth Edition. Publication MWPS-6, Midwest Plan Service, Ames, Iowa (www.mwps.org)

Section 15

Using Winter and Summer Annuals to Ease Seasonal Transitions

Deidre Harmon, UGA

Section 16

Economics of Better Grazing Management

Dr. Levi Russell, UGA

Mississippi State University Extension Service

ROTATIONAL GRAZING: WILL IT PAY?

The beef industry is important to the agricultural economy of Mississippi. According to the National Agricultural Statistics Service[1], the value of cattle and calf production in Mississippi totaled more than $218 million in 2000, placing cattle fifth in terms of value of sales for Mississippi agricultural and forestry products. This represents the production from 24,000 beef operations managing a total of about 1.1 million cattle.

Cattle production takes place in virtually every part of the state. Beef production is probably more widespread than production of any other commodity. According to the Mississippi Agricultural Statistics Service, cash receipts from cattle and calf sales in 2000 exceeded $1 million dollars in 66 of the state's 82 counties. Because beef production is so important to our state, efforts to improve profits of beef operations have tremendous potential to impact our agricultural economy.

A closer look at cost and return data from beef operations suggests that improving the productivity and use of forages provides a real opportunity to increase net returns for beef producers. One of the best ways to reduce feed costs is to provide more of the herd's nutritional requirements through grazing standing forage. Data from the Iowa State Beef Cow Business Record program illustrates this point very clearly.[2] According to this program's production records from 1995 through 2000, the most profitable 25 percent of producers fed 880 pounds less harvested feed per cow than did the least profitable 25 percent of producers (3,509 pounds/cow compared to 4,388 pounds/cow). Differences in feed costs directly translate into significant differences in the bottom line: the most profitable producers realized an average return to capital, labor, and management of $127/cow, whereas the least profitable producers realized an average return of -$144/cow. Given a climate that permits a much longer grazing season than in Iowa, Mississippi producers should be able to reduce harvested feed needs well below the levels in this example.

Producers who want to change their forage management systems to make their livestock operations more productive are faced with two questions: how do I get more out of my forages, and how much will it pay to do so? The answer to the first question is more-or-less straightforward. The management practices that increase the productivity of pasture-based livestock systems are well known and have been promoted by agronomists and animal scientists for years. Things like fertilizing according to soil test results and controlling access to forages through some type of pasture rotation have been shown to increase the productivity of pasture-based livestock production systems in countless university demonstrations as well as on many working farms and ranches.

The second question – how to make improved forage production systems pay – is much more difficult to answer. It is not enough simply to produce more forage. That forage must be fully used in producing livestock to be of value. Implementing an improved forage production system and making the fullest use of the available forage will involve significant changes in management from traditional continuous grazing of perennial pastures. It may also involve significant capital investment. These two factors – the need for more intensive management and for an increase in capital investment – represent significant barriers to adopting improved grazing systems; however, improved grazing systems often represent a great opportunity for producers to enhance the long-term sustainability of their livestock operations.

If you are considering adopting improved pasture systems, you should note several things. First, recognize that successfully operating improved grazing systems requires a greater commitment to

management than traditional continuous grazing systems. Timely pasture rotation and routine pasture maintenance require a level of management many producers (such as part-time producers with significant off-farm commitments of their time) may find burdensome. In addition to the obvious management obligations, rotational grazing systems can give rise to herd health and nutrition management issues that can be different from those of continuous grazing systems. Increasing beef production per acre in a forage-based production system is generally possible through increasing forage production, improving the efficiency of use, and/or managing stocking rates more closely. However, that does not guarantee increased profits. Without the producer's commitment to acquire new skills and make significant changes, intensive grazing systems are unlikely to be successful.

The second fact to point out is that implementing intensively managed grazing systems will involve additional costs. Improving pastures, putting up fences, and installing watering systems cost money. Recovering these costs will require an offsetting increase in revenue — for example, from increased beef production and/or the sale of extra hay. In spite of these considerations, though, moving to more intensively-managed grazing systems can increase profits and enhance the sustainability of livestock operations.

INTENSIVE GRAZING FOR COW/CALF PRODUCERS

In thinking about shifting from a continuous to a more management-intensive grazing system, you should first consider whether or not the long run profitability of the farm will be improved. To do this, a partial budget can be a very useful tool. Basically, a partial budget is made up of four components; two identify changes in the operation that will increase profits, and two identify changes in the operation that will decrease profits. Interpreting the results of a partial budget is very simple: if increased profits exceed decreased profits, then the change is a good one.

1) Changes that Increase Revenue	2) Changes that Decrease Revenue
+ 3) Changes that Reduce Costs	+ 4) Changes that Increase Costs
Increased Profits	Decreased Profits

The difficulty in applying a partial budget to a particular problem is accounting for all cost and return changes that will result. Each profit-changing item must be included to determine whether or not the change to more intensive grazing will be profitable.

Very often, the reason for moving to intensive grazing is to increase revenues (item 1) from the livestock operation. These increased returns will result from selling heavier weights, stocking more head on the same ground, or both.

Cost savings (item 3) may not be an obvious area, but if improved nutrient management leads to reduced fertilizer needs or if pasture clipping or forage harvesting are reduced, you should include these costs. Additionally, costs associated with feeding hay may be reduced, since more forage is harvested by grazing rather than mechanically.

Generally, we would not expect to see decreased revenues (item 2). However, if the plan were to reduce the size of the herd and graze fewer acres, then there might be an entry in the decreased revenue section.

Increased costs (item 4) are often the most obvious items to include in a partial budget. Pasture renovation costs, fencing costs, and water system upgrades are readily identified costs associated with increased rotational grazing. Less obvious, but no less important, are management and labor costs and other costs associated with producing more pounds of meat. Certainly, if rotational grazing adds animals to the herd, then acquisition and ownership costs of the extra animals should be included.

A COW/CALF EXAMPLE

Following is an example of a 70-cow beef operation considering a move to rotational grazing. Keep in mind this is simply "an" example, not "the" example. There is far too much variability in herds, resources, and management to make a blanket statement about the profitability of such a decision.

ABC Farms currently has 70 cows grazing 200 acres of typical Mississippi pasture. The partial budget put together for the farm is based on the assumption that rotational grazing and improved pastures will allow an increase in stocking rates of 30 percent (that is, 21 head). In addition, implementing rotational grazing will reduce nitrogen fertilization requirements and the amount of hay fed through the winter. In spite of the increased revenue and decreased costs, with $300 calves, $700 replacements, and $350 cull cows, this is not a break-even proposition. The operation would lose about $875 on the transition to rotational grazing. Four-hundred-dollar calves present a different story. Profits would increase by almost $1,100 when stocking rates increase by 30 percent. On the next page is a complete summary of the partial budget for this example (assuming $400 calves):

ABC FARMS: *Annualized Partial Budget of Cow/Calf Expansion*

Increased Revenue		**Decreased Revenue**	
Additional Calves	19	None	
Revenue/calf	$400		
Additional Calf Revenue	$7,600	**Increased Costs**	
		Woven Wire Fence	$389
Extra Hay (tons)	18	Poly Tape Fence	697
Revenue/ton	$45	Underground Water Line	265
Additional Hay Revenue	$810	Portable Water System	195
		Pasture Renovation	1,530
		Investment in Cows	1,801
Decreased Costs		Subtotal	$4,877
Reduced N fertilization (30 lbs/ac on 200 acres @ $0.30/lb of N)	$1,800	Additional Labor (15 hrs/mo for 6 months @ $7/hour)	$630
Decreased Hay Feeding (600 lbs/head to 70 head @ $45/ton)	$945	Additional Cow Costs (25 more cows @ variable cost of $180/hd)	$4,500
Increased Profits	**$11,155**	**Decreased Profits**	**$10,007**
Change in Profits: $11,155 - $10,007 = $1,142			

Other assumptions critical to this analysis include investment in new fencing and water facilities of $7,496, costs for overseeding ryegrass of $51/acre on 30 acres, and $14,700 for herd expansion (21 additional cows at $700 per head). Here is a summary of investment in new facilities and equipment, including the calculation of additional costs on an annual basis:

ABC FARMS: *Investment in Rotational Grazing System*

Cow/Calf Example

	Price	Cost	Life	Repair %	Deprec.	Repairs & Maint.	Non-cash Interest
1/2 mile woven wire	$1.05/ft	$2,772	20	5%	$139	$139	$111
2.5 miles poly tape	$0.12/ft	$1,584	5	20%	$317	$317	$63
1/2 mile underground water line	$1.00/ft	$2,640	25	2%	$106	$53	$106
Portable water system	$500	$500	5	15%	$100	$75	$20
21 Cows	$700	$14,700	8	N/A	$919	N/A	$882
Total		**$22,196**					

Total new investment equals $22,196 in this example. From a cash flow standpoint, a five-year loan for this amount at 8% interest would require principle and interest payments of $5,560 per year. The principle and interest payments plus additional variable cost of $6,660 would result in a negative cash flow of about $1,100 per year until the loan was paid off. Here is a summary of this cash flow situation:

ABC FARMS: ***Cash Flow Requirements for Implementation of Rotational Grazing***

Cow/Calf Example

Loan payment		$5,560
$22,196 financed for 5 years @8%		
Additional variable costs		$6,660
Increase in cow variable costs	$4,500	
Additional labor costs	$630	
Annual pasture overseeding	$1,530	
Total additional cash flow requirements		$12,220
Increase in available cash (from earlier table)		$11,155
Net Cash Flow*		($1,065)

** Represents average annual cash flow situation until the loan financing grazing system investment is paid.*

If only the cattle were financed, with other investments financed out-of-pocket, the principle and interest payment would be $3,682. In this situation, a positive cash flow of just more than $800 would appear to be possible.

Remember, this is only one example. Different cost and return assumptions will lead to different results. In addition, different assumptions related to what portion of the new investment is financed and to the terms of that financing could lead to very different cash flow situations. Each situation must be evaluated on its own merit and all changes in revenue and costs must be identified and included.

A STOCKER CALF EXAMPLE

The goal of intensive grazing does not necessarily have to be expanding the cow herd. If you are seeking to diversify into other types of livestock production, you might consider intensive grazing as a means of creating capacity for additional livestock enterprises on the same land base. Grazing stocker calves in addition to the cow herd is an example of this type of system. Seasonally grazing stocker calves could, in fact, be easier to implement than expanding the cow herd. As the previous example shows, expanding the cow herd can lead to a very tight cash flow situation. Either you must repay a large loan (if you financed buying the cows), or you must reduce heifer marketings (if the expansion occurs through increased heifer retention). Either way, an uncomfortably long period of low or negative cash flows can result from the move to intensive grazing. This may be the case even if intensive grazing is expected to improve the long-run profitability of the farm.

Beginning a stocker operation may have less of an impact on cash flow because you keep calves for a relatively short time and then re-sell (or sell for the first time in the case of retained calves). Thus, cash flow is generated more quickly than with brood cows. In addition, in grazing-based stocker systems, there is minimal cash outlay for feed.

In spite of these points, stocker operations are not for everybody. Stocker operations tend to be quite capital intensive. That is, they can tie up much of a farm's equity. Producers with limited equity may find it difficult to finance a stocker operation. In addition, management challenges in a stocker operation can be significantly different from those in a cow/calf operation. For example, monitoring herd health and treating illnesses in a timely and effective manner are absolutely essential to the success of a stocker operation. This requires experience and technical skill that cow/calf producers may have to acquire.

To illustrate how beginning a stocker operation may affect the rotational grazing decision, we will look at the ABC Farms partial budget again. In this case, though, instead of increasing the size of the cow herd by 30%, the owners of the farm are considering running stocker calves on ryegrass pasture. In this example, 300-pound stocker calves will be purchased each year for grazing from the beginning of November through the end of April.

Referring to the partial budget in the earlier example and the assumptions in the second example, all fencing and watering equipment will remain the same. In addition, $1,500 will be spent on handling/feeding facilities for the stockers. The budget below assumes 40 acres of prepared seedbed ryegrass will be planted each fall, which should provide enough grazing for 80 calves. Note that the stocker purchase is given in the increased cost portion of the partial budget.

ABC FARMS: *Annualized Partial Budget of Seasonal Stocker Operation*

Increased Revenue		**Decreased Revenue**	
Fall Stockers	78	None	
Revenue/calf	$450		
Revenue from Fall Stockers	$35,100		
		Increased Costs	
Extra Hay (tons)	18	Woven Wire Fence	$389
Revenue/ton	$45	Poly Tape Fence	697
Additional Hay Revenue	$810	Underground Water Line	265
		Portable Water System	195
Decreased Costs		Ryegrass Planting	2,240
Reduced N fertilization (30 lbs/ac on 200 ac @ $0.30/lb of N)	$1,800	Facilities	360
		Stockers (80 @ $350/head)	28,000
		Labor ($5/head)	400
		Variable Costs ($30/head)	2,400
Increased Profits	**$37,710**	**Decreased Profits**	**$34,946**
Change in Profits: $37,710 - $34,946 = $2,764			

In this example, implementing intensive grazing along with a seasonal stocker-grazing program increases profits by about $2,700. Cash flow implications are also significant. Buying stocker calves each year requires $28,000 in this example, although that will obviously vary from year to year, depending on the cattle market. Total investment in facilities and fencing/watering equipment is $8,996 (cost of fencing and watering equipment plus an additional $1,500 invested in facilities). Financed for five years, this results in an annual payment of $2,253. Additional variable costs (including interest on calf purchases) and labor total $2,800. In addition, the cost of planting ryegrass each year (40 acres @ $56/ac) is assumed to be paid out-of-pocket as well. The total annual cash flow requirement for the operation is, therefore, just more than $35,000 ($2,253 loan payment + $2,800 additional variable costs + $2,240 ryegrass planting cost + $28,000 calf purchases). Thus, in this example, positive cash flow is possible. Obviously, this cash flow will be affected by the profitability of the stocker operations in any given year as well as by the terms of financing on the investment in facilities and fencing/watering equipment.

The examples presented here illustrate the importance of budgeting production and price parameters that are realistic for the individual farm. General statements about the value of rotational grazing could be misleading because of very significant differences in pasture quality, field layout, water availability, and management ability among farms. What can be stated categorically is that the economic benefits of rotational grazing depend on the cattle price as well as costs of implementing the system. Producers who implement rotational grazing need to be aware not only of how this management change will affect the long-run profitability of their operations but also of how their cash flow will be affected in the short- and intermediate run. Herd expansion, in particular, may have a pronounced negative effect on cash flow, depending upon how the expansion is financed and/or the time frame over which the expansion occurs.

For additional information on fencing systems and associated costs, see Gerrish, Jim, "Fence Systems for Grazing Management," Arkansas Grazing Manual, 5th ed., University of Arkansas Cooperative Extension Service; Turner, L.W., C.W. Absher, and J. K. Evans, Planning Fencing Systems for Intensive Grazing Management, ID-74, University of Kentucky Cooperative Extension Service, 1997; or Mayer, Ralph, Estimated Costs for Livestock Fencing, FM 1855, Iowa State University Extension, February 1999.

[1] Data taken from Meat Animals: Production, Disposition, and Income, USDA-NASS, Washington DC, April 2001; and Cattle, USDA-NASS, Washington DC, January 2001.

[2] From 2000 Summary: Iowa Beef Cow Business Record, IBC-16, Iowa State University Extension, July 2001.

ROTATIONAL GRAZING: WILL IT PAY?

Mississippi State University Extension Service

msucares.com

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Partial Budgeting Form for_____

Additional Costs	**Additional Revenue**
Reduced Revenue	**Reduced Costs**
Total additional costs +reduced revenue = A	**Total additional revenue +reduced costs = B**

Total Profit = B-A

ANNUAL PAYMENTS FOR $1,000 AT VARIOUS INTEREST RATES AND YEARS TO PAYBACK

NUMBER OF YEARS TO PAYBACK	INTEREST RATE					
	3.00%	4.00%	6.00%	8.00%	10.00%	12.00%
1	$1,030.00	$1,040.00	$1,060.00	$1,080.00	$1,100.00	$1,120.00
2	$522.61	$530.20	$545.44	$560.77	$576.19	$591.70
3	$353.53	$360.35	$374.11	$388.03	$402.11	$416.35
4	$269.03	$275.49	$288.59	$301.92	$315.47	$329.23
5	$218.35	$224.63	$237.40	$250.46	$263.80	$277.41
6	$184.60	$190.76	$203.36	$216.32	$229.61	$243.23
7	$160.51	$166.61	$179.14	$192.07	$205.41	$219.12
8	$142.46	$148.53	$161.04	$174.01	$187.44	$201.30
9	$128.43	$134.49	$147.02	$160.08	$173.64	$187.68
10	$117.23	$123.29	$135.87	$149.03	$162.75	$176.98
15	$83.77	$89.94	$102.96	$116.83	$131.47	$146.82
20	$67.22	$73.58	$87.18	$101.85	$117.46	$133.88
25	$57.43	$64.01	$78.23	$93.68	$110.17	$127.50
30	$51.02	$57.83	$72.65	$88.83	$106.08	$124.14
35	$46.54	$53.58	$68.97	$85.80	$103.69	$122.32
40	$43.26	$50.52	$66.46	$83.86	$102.26	$121.30

To use this table, simply multiply the amount financed (in thousands) by the appropriate payback period and interest rate. For example, the annual payments for $100,000 in principal paid back over 10 years at 8% interest would be $14,903. This payment is determined by locating the intersection of 10 years and 8% which is $149.03 and then multiplying this number by 100 ($100,000 divided by $1,000)

Section 17

Sprayer Calibration Exercise and Lightbar Demo

Dr. Dennis Hancock, UGA

CALIBRATION METHOD FOR BOOMLESS BROADCAST SPRAYERS

Gary L. Hawkins, Extension Engineer
Glen C. Rains, Extension Engineer

All sprayers should be calibrated often to ensure that pesticide is being applied at the correct rate. Most broadcast applications are made with a boom arrangement where the nozzle tips are spaced evenly along the boom. However, in some situations this may be impossible or undesirable, so a cluster nozzle or a single nozzle with a wide spray pattern may be used.

Calibrate with clean water when applying toxic pesticides mixed with large volumes of water. When applying materials that are appreciably different from water in weight or flow characteristics, such as fertilizer solutions, etc., calibrate with the material to be applied. Exercise extreme care and use protective equipment when active ingredient is involved.

The following instructions outline a simple method to calibrate a boomless broadcast sprayer.

Step 1. Determine spray width. The spray width is the distance between successive passes through a field. This is usually given in the manufacturers' literature for a specific nozzle. If you are unable to find this in the catalogs, use 80 to 85 percent of the wetted spray width.

Step 2. Using the spray width in Step 1, determine the calibration distance from Table 1.

Step 3. Measure and mark calibration distance on typical terrain to be sprayed.

Step 4. With all attachments in operation and traveling at the desired operating speed, determine the number of seconds it takes to travel the calibration distance. Be sure machinery is traveling at full operating speed the full length of the calibration distance. Mark or make note of engine RPM and gear. Machine must be operated at same speed for calibration.

Step 5. With sprayer sitting still and operating at same throttle setting or engine R.P.M. as used in Step 4, adjust pressure to the desired setting. Machine must be operated at same pressure used for calibration.

Step 6. Collect spray from all nozzles or outlets for the number of seconds required to travel the calibration distance.

Table 1. Calibration distances with corresponding widths.

SWATH WIDTH (feet)	CALIBRATION DISTANCE (feet)
40	85.1
38	89.5
36	94.5
32	106.3
30	113.4
28	121.5
24	141.8
20	170.2
18	189
16	212.7
12	283.6
10	340.3
8	425

To determine distance for swath width not listed, divide the swath width expressed in feet into 340.3 and multiply by 10.
Example: for 13 feet swath the calibration distance would be 340.3 divided by 13 multiplied by 10 = 261.8.

CALIBRATION METHOD FOR BOOMLESS BROADCAST SPRAYERS

Step 7. Measure the amount of liquid collected in fluid ounces.

Step 8. Divide the total number of fluid ounces by 10 to obtain gallons per acre applied. For example, if you collect 180 ounces, the sprayer will apply 18 gallons per acre. Adjust applicator speed, pressure, nozzle size, etc. to obtain recommended rate. If speed is adjusted, start at Step 3 and recalibrate. If pressure or nozzles are changed, start at Step 5 and recalibrate.

Step 9. To determine amount of pesticide to put into a sprayer or applicator tank, divide the total number of gallons of mixture to be made (tank capacity for a full tank) by the gallons per acre rate from Step 8 and use recommended amount of pesticide for this number of acres.

CAUTION: AGRICULTURAL CHEM ICALS CAN BE DANGERO US. IMPROPER SELECTION OR USE CAN SERIOUSLY INJURE PERSONS, ANIMALS, PLANTS, SOIL, OR OTHER PROPERTY. BE SAFE: SELECT THE RIGHT CHEMICAL FOR THE JOB. HANDLE IT WITH CARE. FOLLOW THE INSTRUCTIONS ON THE CONTAINER LABEL AND INSTRUCTIONS FROM THE EQUIPMENT MANUFACTURER.

CALIBRATION METHOD FOR GRANULAR APPLICATIONS

Gary L. Hawkins, Extension Engineer
Glen C. Rains, Extension Engineer

Applicators used in granular applications should be calibrated to insure uniformity and accuracy of the application. A more accurate and uniform application can reduce the quantity of an active ingredient required for a given degree of control, which benefits the environment as well as the producer.

Several factors influence the amount of granular material applied to a given area. Granular material is usually metered with an adjustable orifice. The amount of material that flows through the orifice per revolution relies on orifice opening size and may rely on rotor speed. A wide variation in product characteristics, such as size, density, and shape, requires that a calibration be made for every chemical applied. Also changes in climatic conditions, such as temperature and humidity, can result in a different flow rate.

CAUTION: Calibration is done using the chemical to be applied. Protective equipment, such as rubber gloves, etc. should be used to avoid contact with the chemicals to be applied.

Granular application is usually done in combination with another operation, such as planting or cultivating. The applicator may be ground driven or driven with a small electric motor. The following procedure will give the pounds (total weight) of material applied per acre broadcast or row basis as indicated. A weight scale incremented in ounces is required for this procedure.

Step 1. Determine type of application to be made and select appropriate procedure from Table 1. Example - Broadcast - Procedure A.

Table 1. Corresponding procedures for different spray applications.

TYPE OF APPLICATION	PROCEDURE	COVERAGE BASIS (VOLUME OF APPLICATION)
Broadcast	A	Broadcast (lbs /acre)
Band	B	Broadcast (lbs/acre of band)
Row (See note)	C (Use this procedure when rates are given for row treatment)	

Note: Determine and use average row spacing for modified row patterns. Use width of area covered per row as row spacing in skip row patterns for broadcast rates

Step 2. Using procedure A, B, or C below as selected in Step 1, determine appropriate calibration distance from Table 2.

(A) Broadcast Application: Outlets must be evenly spaced. Measure outlet spacing. Find this spacing in left column of Table 2 and read the corresponding calibration distance. Example - for a 19” spacing the distance would be 214.9 feet.

(B) Band Application: Measure band width. Find this band width in the left column of Table 2 and read the corresponding calibration distance. Example - for a 12” band, the distance would be 340.3.

(C) Row Application: Measure row spacing for evenly spaced rows. Find this row spacing in the left column of Table 2 and read the corresponding calibration distance from the column on the right. Example - for a 38” row spacing, the distance would be 107.5 feet.

CAUTION: AGRICULTURAL CHEMICALS CAN BE DANGEROUS. IMPROPER SELECTION OR USE CAN SERIOUSLY INJURE PERSONS, ANIMALS, PLANTS, SOIL, OR OTHER PROPERTY. BE SAFE: SELECT THE RIGHT CHEMICAL FOR THE JOB. HANDLE IT WITH CARE. FOLLOW THE INSTRUCTIONS ON THE CONTAINER LABEL AND INSTRUCTIONS FROM THE EQUIPMENT MANUFACTURER.

Step 3. Measure and mark calibration distance in a typical portion of the field to be applied.

CALIBRATION METHOD FOR GRANULAR APPLICATIONS

Step 4. With all attachments in operation (harrows, planters, etc.) and traveling at the desired operating speed, determine the number of seconds it takes to travel calibration distance. Be sure machinery is traveling at full operating speed the full length of the calibration distance. Mark or make note of engine RPM and gear. Machine must be operated at same speed for calibration.

Step 5. **Multiply the number of seconds required to travel calibration distance by 8**. This is the number of seconds to collect.

Step 6. With applicator sitting still and operating at same speed as used in Step 4, adjust gate openings to desired setting. Check uniformity of outlets across the swath or rows. Collect from each outlet for a known time period. Each outlet should be within 5 percent of the average outlet output.

Table 2. Calibration distances with corresponding widths.

ROW SPACING, OUTLET SPACING OR BAND WIDTH (Whichever Applies) (Inches)	CALIBRATION DISTANCE (feet)
48*	85.1
46	88.8
44	92.8
42	97.2
40	102.1
38	107.5
36	113.4
32	127.6
30	136.1
24	170.2
20	204.2
19	214.9
18	226.9
14	391.7
12	340.3
10	408.4
8	510.5

To determine distance for spacing or band width not listed, divide the spacing or band width expressed in feet into 340.3.
Example: for a 13-inch band the calibration distance would be 340 divided by 13/12 = 314.1.

* To increase calibration accuracy for a wide outlet spacing, multiply calibration distance by a factor (for example, 2); then, divide Step 8 material collected by the same factor for pounds per acre. For narrow spacings with long calibration distances, divide calibration distance by a factor (for example, 4); then, multiply Step 8 by the same factor for pounds per acre. Keep in mind that application accuracy will decrease when factoring narrow outlet or band spacings.

Step 7.**For procedure (A), Step 2, broadcast application, collect from one outlet for the number of seconds indicated in Step 5.
For procedure (B), Step 2, band application, collect from all outlets used on one band width for the number of seconds indicated in Step 5. For procedure (C), Step 2, row application, collect from all outlets used for one row for the number of seconds indicated in Step 5.
**** For ground driven equipment, multiply the calibration distance by 8 and collect from each outlet while traveling the calibration distance; then divide step 8 material collected by 8**

for pounds per acre.

Step 8. Weigh the amount of material collected in ounces. The number of ounces collected is the pounds per acre rate on the coverage basis indicated in Table 1. For example, if you collect 18 ounces using procedure (A) or (B), the applicator will apply 18 pounds per acre on a broadcast coverage basis. Adjust applicator speed, gate opening, etc. to obtain recommended rate.

Step 9. Applicators should be checked for proper calibration every 4-8 hours of use. Simply repeat steps 7 and 8. If there is a difference of more than 5 percent of original calibration, check the system.

Band Application

Use the recommended **broadcast** pesticide rates to make tank mixtures for band applications when calibrating with Procedure B of this method. The number of gallons per acre determined in Step 7 is the gallons that will be applied to each acre of actually treated band.

To determine the gallons of spray mixture required to make a band application on a field, the number of acres that will be in the treated band must be determined. When all treated bands are the same width and all untreated bands are the same width, which is usually the case, the acres in the treated band can be calculated by placing the width of the treated band over the sum of the widths of the treated band and the untreated band, and multiplying this fraction times the number of acres in the field. Example - How many acres will actually be treated in a 30 acre field if a 12-inch band of chemical is applied over the drill of rows spaced 36-inches apart. The treated band width is 12 inches. The untreated band width is (36 inches – 12 inches) = 24 inches. Acres actually treated will be 12 inches divided by (12 inches + 24 inches) times 30 acres equals 10 acres. The amount of mixture required will be 10 times the number of gallons per acre from Step 7. The amount of chemical required will be 10 times the recommended broadcast rate for one acre.

Check rate recommendations carefully as to type of application, broadcast, band or row, and type of material specified, formulated product, active ingredient, etc.

Calculating Formulation Requirements For Active Ingredient Rates.

To determine amount of liquid pesticide required for a rate given in pounds of active ingredient per acre, divide recommended rate by pounds active ingredient per gallon stated on label. Example – Pesticide label states 4 lbs. active ingredient (AI) per gallon and recommends 1/2 pound AI per acre. Amount of pesticide required: 1/ 2 lb. AI per acre divided by 4 lb. AI per gal. = 1/8 gal. per acre.

To determine amount of wettable powder required for a rate given in pounds active ingredient per acre, divide recommended rate by percent active ingredient stated on label. Example - Pesticide label states powder is 50% active ingredient. Two pounds of active ingredient is recommended per acre. Amount of pesticide powder required: 2 lbs. AI per A divided by 0.5 AI per lb. = 4 lbs. per acre

CALIBRATION METHOD FOR HYDRAULIC BOOM AND BAND SPRAYERS, AND OTHER LIQUID APPLICATORS

Gary L. Hawkins, Extension Engineer
Glen C. Rains, Extension Engineer

The procedure below is based on spraying 1/128 of an acre per nozzle or row spacing and collecting the spray that would be released during the time it takes to spray the area. Because there are 128 ounces of liquid in 1 gallon, this convenient relationship result in ounces of liquid caught being directly equal to the application rate in gallons per acre.

Calibrate with clean water when applying toxic pesticides mixed with large volumes of water. Check uniformity of nozzle output across the boom. Collect from each for a known time period. Each nozzle should be within 10 percent of the average output. Replace with new nozzles if necessary. When applying materials that are appreciably different from water in weight or flow characteristics, such as fertilizer solutions, etc., calibrate with the material to be applied.

Exercise extreme care and use protective equipment when active ingredient is involved.

Step 1. Determine type of application to be made and select appropriate procedure from Table 1. For example, for a Herbicide Broadcast, use Procedure A.

Table 1. Corresponding procedures for different spray applications.

TYPE OF APPLICATION	PROCEDURE	COVERAGE BASIS
	Herbicide, Insecticide, Nematicide, Fungicide, or Liquid Fertilizer	
Broadcast	A	Broadcast (gal/ acre)
Band	B	Broadcast (gal/acre of band)
Row (See note)	C (Use this procedure when rates are given for row treatment)	

Note: Determine and use average row spacing for modified row patterns. In skip row patterns, use width of area covered per row as row spacing.

Step 2. Determine and use average row spacing for modified row patterns. In skip row patterns, use width of area covered per row as row spacing.

(A) Broadcast Application: Outlets or nozzles must be evenly spaced. Measure outlet (nozzle, etc.) spacing. Find this spacing in left column of Table 2 and read the corresponding calibration distance. For example, for a 19-inch spacing the distance would be 214.9 feet.

(B) Band Application: Measure band width. Find this band width in the left column of Table 2 and read the corresponding calibration distance. For example, for a 12-inch band, the distance would be 340.3.

(C) Row Application: Measure row spacing for evenly spaced rows. Find this row spacing in the left column of Table 2 and read the corresponding calibration distance from the column on the right. For example, for a 38-inch row spacing, the distance would be 107 .5 feet. (See note above for modified and skip rows.)

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Step 3. Measure and mark calibration distance in a typical portion of the field to be sprayed.

Step 4. With all attachments in operation (harrows, planters, etc.) and traveling at the desired operating speed, determine the number of seconds it takes to travel calibration distance. Be sure machinery is traveling at full operating speed the full length of the calibration distance. Mark or make note of engine RPM and gear. Machine must be operated at same speed for calibration.

Step 5. With sprayer sitting still and operating at same throttle setting or engine R.P.M. as used in Step 4, adjust pressure to the desired setting. Machine must be operated at same pressure used for calibration.

Step 6. For Procedure A, Step 2, broadcast application, collect spray from one nozzle or outlet for the number of seconds required to travel the calibration distance.

For Procedure B, Step 2, band application, collect spray from all nozzles or outlets used on one band width for the number of seconds required to tr avel the calibration distance.

For Procedure C, Step 2, row application, collect spray from all outlets (nozzles, etc.) used for one row for the number of seconds required to travel the calibration distance.

Table 2. Calibration distances with corresponding widths.

ROW SPACING, OUTLET SPACING OR BAND WIDTH (Whichever Applies) (Inches)	CALIBRATION DISTANCE (feet)
48**	85.1
46	88.8
44	92.8
42	97.2
40	102.1
38	107.5
36	113.4
32	127.6
30	136.1
24	170.2
20	204.2
19	214.9
18	226.9
14	291.7
12	340.3
10	408.4
8	510.5

To determine distance for spacing or band width not listed, divide the spacing or band width expressed in feet into 340.3. Example: for a 13" band the calibration distance would be 340 divided by 13/12 = 314.1.

** To increase calibration accuracy for a wide nozzle spacing, multiply calibration distance by a factor (for example, 2); then, divide the fluid amount collected by the same factor for GPA. For narrow nozzle spacings with long calibration distances, divide calibration distance by a factor (for example, 4); then, multiply the fluid amount collected by the same factor for GPA.

Step 7. Measure the amount of liquid collected in fluid ounces. The number of ounces collected is the gallons per acre rate on the coverage basis indicated in Table 1. For example, if you collect 18 ounces, the sprayer will apply 18 gallons per acre. Adjust applicator speed, pressure, nozzle size, etc. to obtain recommended rate. If speed is adjusted, start at Step 4 and recalibrate. If pressure or nozzles are changed, start at Step 5 and recalibrate.

Step 8. To determine amount of pesticide to put into a sprayer or applicator tank, divide the total number of gallons of mixture to be made (tank capacity for a full tank) by the gallons per acre rate from Step 7 and use recommended amount of pesticide for this number of acres.

CALIBRATION METHOD FOR HYDRAULIC BOOM AND BAND SPRAYERS, AND OTHER LIQUID APPLICATORS

Band Application

Use the recommended **broadcast** pesticide rates to make tank mixtures for band applications when calibrating with procedure (B) of this method. The number of gallons per acre determined in Step 7 is the gallons that will be applied to each acre of actually treated band.

To determine the gallons of spray mixture required to make a band application on a field, the number of acres that will be in the actually treated band must be determined. When all treated bands are the same width and all untreated bands are the same width, which is usually the case, the acres in the actually treated band can be calculated by placing the width of the treated band over the sum of the widths of the treated band and the untreated band, and multiplying this fraction times the number of acres in the field. Example - How many acres will actually be treated in a 30 acre field if a 12" band of chemical is applied over the drill of rows spaced 36" apart. The treated band width is 12". The untreated band width is (36" - 12") = 24". Acres actually treated will be 12" divided by (12" + 24") times 30 acres equals 10 acres. The amount of mixture required will be 10 times the number of gallons per acre from Step 7. The amount of chemic al required will be 10 times the recommended broadcast rat e for one acre.

Check rate recommendations carefully as to type of application, broadcast, band or row, and type of material specified, formulated product, active ingredient, etc.

Calculating Formulation Requirements For Active Ingredient Rates.
To determine amount of liquid pesticide required for a rate given in pounds of active ingredient per acre, divide recommended rate by pounds active ingredient per gallon stated on label. Example – Pesticide label states 4 lbs. active ingredient (AI) per gallon and recommends 1/2 pound AI per acre. Amount of pesticide required: 1/ 2 lb. AI per acre divided by 4 lb. AI per gal. = 1/8 gal. per acre

To determine amount of wettable powder required for a rate given in pounds active ingredient per acre, divide recommended rate by percent active ingredient stated on label. Example - Pesticide label states powder is 50% active ingredient. Two pounds of active ingredient is recommended per acre. Amount of pesticide powder required: 2 lbs. AI per A divided b y 0.5 AI per lb. = 4 lbs. per AI

CALIBRATION OF BACKPACK SPRAYERS 1000 Ft^2 Method

Gary L. Hawkins, Extension Engineer
Glen C. Rains, Extension Engineer

Backpack sprayers are often used to treat ornamental or small areas of turf. Herbicide recommendations are based amount per acre and amount per 100 0 ft^2. Regardless of the type of sprayer used to apply herbicides, the speed, pressure and nozzle height must be kept constant for accurate application. The backpack sprayer may require some modification so that it is better suited for application. A pressure gauge mounted on the tank side of the shutoff valve will allow continuous monitoring of the tank pressure, which must remain uniform. Optimum pressure control can be achieved by inserting a pressure regulator between the pressure gauge and nozzle. To prevent dripping after the shutoff valve is closed, use a quick, positive pressure shutoff valve or a strainer with a check valve. Nozzle clogging, a problem associated with the use of wettable powders (as well as dry flowable [DF] and water dispersible granular [WDG] formulations) can be reduced by inserting a 50 mesh in-line strainer and keeping the solution constantly agitated. The following is a procedure of 1000 ft^2.

Step 1. Measure the length and width of the test area to be sprayed. Then calculate the area to be covered.

Test Area is: lengthft X width ft = _____ ft^2 _____

Step 2. Fill sprayer with water and spray the test area. Record the amount of water to refill the sprayer.

Volume (ounces) per test area _____

Step 3. Find the label rate of material to be applied per 1000 ft^2 .

Rate _____per 1000 ft^2

Step 4. $$\frac{\textit{1000 ft}^2 \textit{ x Volume (ounces) per test area}}{\textit{Test Area (ft}^2\textit{)}} = \textit{Volume (ounces) per 1000 ft}^2$$

Step 5. Calculate the area covered per tank as follows:

$$\frac{\textit{Tank volume (ounces) x 1000 ft}^2}{\textit{Volume per 1000 ft}^2} = \textit{Area covered per tank (ft}^2\textit{)}$$

Step 6. Calculate amount of material to add to tank.

$$\frac{\textit{Area per tank (ft}^2\textit{) x Label rate per 1000 ft}^2}{\textit{1000}} = \textit{Amount to add (rate units)}$$

Solutions derived from the above may need to be converted to a smaller unit in order to accurately measure the pesticide accurately. The following conversion will help simplify this problem.

Conversions:

VOLUME		WEIGHT	
gallons x 128	= fluid ounces (fl oz)	pounds x 16	= weight ounces (wt oz)
pints x 16	= fluid ounces (fl oz)	wt. ounces x 28.35	= grams (g)
fl oz x 29.57	= milliliters (ml)	grams x 1000	= milligrams (mg)
gallons x 4	= quarts (qts)		
quarts x 2	= pints (pts)		
fl oz x 2	= Tablespoons (Tbs)		
tsp x 3	= Tablespoons (Tbs)		
tsp x 5	= milliliters (ml)		

An example of using this conversion chart. If the rate calls for 0.25 gallons of material then converting to ounces would be done as follows: 1 gallon has 128 ounces, so multiply 0.25 gallons by 128 to get 32 ounces. So, you would need to measure out 32 ounces for your application. The same thing for a weight. If you need 0.25 pounds, then multiply 0.25 by 16. This is calculated as 0.25 pounds times 16 to get 4 weight ounces of material.

PESTICIDE RATE AND DOSAGE CALCULATIONS

Dan Horton, Extension Entomologist

HOW TO CALCULATE PESTICIDE DILUTIONS AND DOSAGES FOR LARGE AREAS

Pesticides for use in sprays are generally available as wettable or soluble powders and as liquid concentrates. These must be diluted, usually with water, before use. Other diluents, such as deodorized kerosene, may be used for special applications.

The precise amount of water applied to an acre (or other given area) is of modest concern as long as gallonage falls within a recommended range, delivers the recommended amount of pesticide, provides adequate coverage, and does not result in excessive runoff or drift. If you know the area (acres, sq. ft., etc.) or units (trees, cows, etc.) covered by a given amount of spray you can determine the dosage or rate of active ingredient each receives by adding the proper quantity of pesticide to that amount of water. Dusts and granules are applied without dilution by the user. Therefore the amount applied per acre or unit is much more critical because you have no other way of controlling the dosage or rate of active ingredient.

The amount of active ingredient in liquid concentrates is expressed in pounds per gallon. In granules, dusts, wettable or soluble powders, and other solids it is nearly always expressed as percent by weight. Application rates are usually expressed as amount of pesticide product but some- times they may be expressed as pounds of active ingredient or actual toxicant. Actual toxicant and active ingredient are practically synonymous.

1. To find the pounds of wettable powder (WP), dust (D) or granules (G) per acre to obtain the desired pounds of active ingredient (a.i.) per acre:

$$\textbf{lbs. of WP, D or G per acre} = \frac{\textbf{lbs. a.i. desired x 100}}{\textbf{\% a.i. in WP, D, or G}}$$

2. To find the pints of liquid concentrate per acre to obtain the desired pounds of active ingredient (a.i.) per acre: pints of liq.
**If you want the answer in gallons, quarts, or fluid ounces substitute l, 4, or l28 respectively for 8.*

$$\textbf{conc. per acre} = \frac{\textbf{lbs. a.i. desired x 8*}}{\textbf{lbs. a.i. per gallon of liq. conc.}}$$

3. To find the amount of wettable powder (WP) or liquid concentrate to use in a given amount of spray:

amt. of WP or liq conc. = no. of acres treated with amount of spray X desired amount of WP or liq. conc. per acre*
**Trees, animal, etc. can be substituted for acres.*

4. To find the pounds of wettable powder needed to obtain a desired percentage of active ingredient in water:

$$\textbf{lbs. of WP} = \frac{\textbf{gals. of spray desired x \% a.i. desired x 8.3**}}{\textbf{\% a.i. in WP}}$$

5. To find the gallons of liquid concentrate needed to obtain a desired percentage of active ingredient in water:
***One gallon of water weighs approximately 8.3 pounds. If another diluent is used the weight per gallon of the other diluent should be substituted for 8.3.*

$$\textbf{gal. of liq. conc.} = \frac{\textbf{gals. of spray desired x \% a.i. desired x 8.3**}}{\textbf{lbs. a.i. per gal. of liq. conc. x 100}}$$

PESTICIDE CONVERSION TABLE FOR LARGE AREAS

LIQUID FORMULATIONS

Amount of Commercial Product to Add to Spray Tank for Each Acre Treated

FORMULATION LBS./GAL. ACTIVE INGREDIENT	Desired Rate Per Acre of Active Ingredient, Lbs.															
	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	1.1	1.5	2	2.5	3	4	6	9
1.5	10 oz	17 oz	26 oz	34 oz	43 oz	51 oz	64 oz	85 oz	96 oz	128 oz	171 oz	213 oz	256 oz	341 oz	512 oz	768 oz
2	8 oz	13 oz	19 oz	26 oz	32 oz	38 oz	48 oz	64 oz	72 oz	96 oz	128 oz	160 oz	192 oz	256 oz	384 oz	576 oz
3	5 oz	9 oz	13 oz	17 oz	21 oz	26 oz	32 oz	43 oz	48 oz	64 oz	85 oz	107 oz	128 oz	171 oz	256 oz	384 oz
4	4 oz	6 oz	10 oz	13 oz	16 oz	19 oz	24 oz	32 oz	36 oz	48 oz	64 oz	80 oz	96 oz	128 oz	192 oz	288 oz
6	2.6 oz	4.3 oz	6.4 oz	9 oz	11 oz	13 oz	16 oz	21 oz	24 oz	32 oz	43 oz	53 oz	64 oz	85 oz	128 oz	192 oz
6.7	2.3 oz	3.8 oz	5.7 oz	7.6 oz	9.6 oz	11.5 oz	14.3 oz	19.1 oz	21 oz	29 oz	38 oz	48 oz	57 oz	76 oz	115 oz	172 oz
7	2.2 oz	3.7 oz	5.5 oz	7.3 oz	9.1 oz	11 oz	13.7 oz	18 oz	20 oz	27 oz	37 oz	46 oz	55 oz	73 oz	110 oz	165 oz
8	2 oz	3.2 oz	4.8 oz	6.4 oz	8 oz	9.6 oz	12 oz	16 oz	18 oz	24 oz	32 oz	40 oz	48 oz	64 oz	96 oz	144 oz

WETTABLE POWDER FORMULATIONS

Pounds of Commercial Product to Add to Spray Tank for Each Acre Treated

% ACTIVE INGREDIENT	Desired Rate Per Acre of Active Ingredient, Lbs.															
	0.2	0.3	0.4	0.5	0.6	0.8	0.8	1	2	2	3	3	4	4	5	8	10
50	0.4	0.6	0.8	1	1.2	1.5	1.6	2	2	3	4	5	6	8	10	16	20
75	0.3	0.4	0.5	0.7	0.8	1	1.1	1.3	2	2	3	3	4	5.3	6.6	10.7	13.33
80	0.3	0.4	0.5	0.6	0.8	0.9	1	1.2	2	2	3	3	4	5	6.2	10	12.5

PESTICIDE CONVERSION TABLE FOR LARGE AREAS (continued)

GRANULES AND DUSTS
Pounds of Commercial Product to Apply Per Acre

% ACTIVE INGREDIENT	Desired Rate Per Acre of Active Ingredient, Lbs.					
	1	2	3	4	5	10
2.5	40	80	120	160	200	400
5	20	40	60	80	100	200
10	10	20	30	40	50	100
15	6.6	13.3	20	26.6	33.3	66.6
20	5	10	15	20	25	50

CONVERSION TABLES FOR SMALL AREAS

LIQUID FORMULATIONS[1]
Amount of Commercial Product to Add to Spray Tank to Treat l000 Sq. Ft.

FORMULATION LBS./GAL. ACTIVE INGREDIENT	Desired Rate Per Acre of Active Ingredient, Lbs.							
	0.25	0.5	1	2	4	8	10	12
0.5	3 Tbs[1] (43.4)[3]	3 oz[2] (86.8)	6 oz (173.7)	11 oz 1 Tbs (347.4)				
1	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	5 oz 1 Tbs (173.7)				
2	2 tsp (10.8)	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	5 oz 1 Tbs (173.7)	11 oz 1 Tbs (342.4)		
4	1 tsp (5.4)	2 tsp (10.8)	1 Tbs 1 tsp (21.7)	3 Tbs (43.4)	3 oz (86.8)	6 oz (173.7)	7 oz 2 tsp (217.1)	8 oz 4 tsp (260.6)

[1] approximate values
[2] refers to level measure
[3] figure in parentheses refers to milliliters

CONVERTING LARGE VOLUME RECOMMENDATIONS TO SMALL VOLUMES OR AREAS

Frequently, pesticide recommendations are given only for large volume applications, i.e. amount per l00 gallons or per acre, but only a small amount is needed. Conversion of liquids to smaller quantities is relatively easy and precise because suitable equipment such as measuring spoons are readily available. While scales sensitive enough to handle small quantities of solid materials are available, it is often more practical to use volumetric measures. Various conversion tables have been prepared on the premise that there are 200 to 300 teaspoons (roughly 2 to 3 pints) per pound of solid pesticide product. These tables are grossly inaccurate because of the wide variation in bulk density among solid pesticide formulations. For instance, a pint of almost any insecticide wettable powder will weigh much less than a pint of fungicide that has a high metal content. Greater accuracy can be obtained if one first determines the weight of a given volume of the solid material and then calculates the volumetric measure. This will usually provide acceptable accuracy but it is still not as accurate as actually weighing a solid formulation. When coupled with a little simple arithmetic the following formulas will enable you to convert large volume recommendations to smaller quantities.

1. To find the amount of liquid concentrate per gallon when label recommendations are given in pints per 100 gallons:
   teaspoons/gallon = recommended pints per 100 gallons x 1*
   or
   teaspoons/gallon = recommended pints per l00 gallons x 0.96
   or
   milliliters/gallon = recommended pints per 100 gallons x 4.73*

2. To find the amount of wettable powder (WP) or other solid formulation per gallon when label recommendations are given as pounds per 100 gallons:
   teaspoons/gallon = recommended lbs./ 100 gals. x cups in 1 lb. of formulation x 0.053*
   or
   teaspoons/gallon = recommended lbs./100 gals. x Tbs. in 1 ounce of formulation x 0.53*
   or
   grams/gallon = recommended lbs./100 gals x 4.54*

3. To find the amount of liquid concentrate to apply per 1,000 square feet when label recommendations are given as pints per acre:
   teaspoons/1,000 sq. ft. = recommended pints/acre x 2.20*
   or
   milliliters/1,000 sq. ft. = recommended pints/acre x 10.9*

4. To find the amount of dust (D), granules (G) or wettable powder (WP) to apply per 1,000 square feet when label recommendations are given as pounds per acre:
   lbs./1,000 sq. ft. = recommended lbs./acre x 0.023*
   or
   Tbs/1,000 sq. ft. = recommended lbs./acre x cups in 1 lb. of formulation x 0.37*
   or
   Tbs/1,000 sq . ft. = recommended lbs./acre x Tbs. in 1 lb. of formulation x 0.023*
   or
   grams/1,000 sq. ft. = recommended lbs./acre x 10.4*

*These values have been rounded off to facilitate calculations.

Section 18

New Weed Management Tools for Grazed Pastures

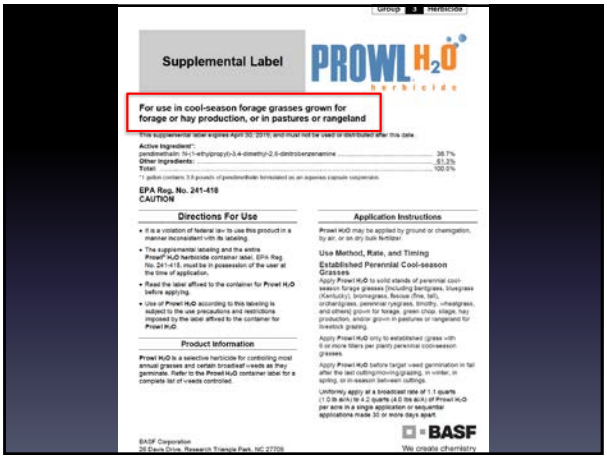
Dr. Patrick McCullough, UGA

2016 Georgia Grazing School:
New weed management tools for grazed pastures

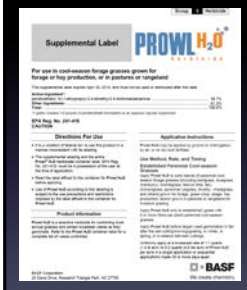
Dr. Patrick McCullough
Assoc. Prof. and Ext. Weed Scientist

Weed Control Update for Grazed Pastures

Patrick McCullough, Ph.D.
University of Georgia


Supplemental Label
PROWL H2O herbicide
For use in cool-season forage grasses grown for forage or hay production, or in pastures or rangeland
EPA Reg. No. 241-418
CAUTION
Directions For Use
Application Instructions
Use Method, Rate, and Timing
Established Perennial Cool-season Grasses
Product Information
BASF
We create chemistry

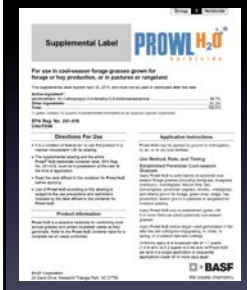
New Labeled Pasture Grasses



- Tall fescue
- Perennial ryegrass
- Orchardgrass
- Timothy
- Wheatgrass
- Mixed stands with alfalfa

Grasses must be 6 or more tillers

New Labeled Directions



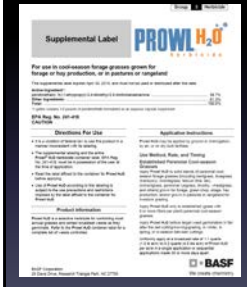
- Fall
  - Apply after last cutting
  - Before weed germination
- Spring
  - Apply when soil temps reach low 50s

Grasses must be 6 or more tillers

Importance of this new label

- Only tool for PRE annual weed control in fescue and cool-season forages
  - Crabgrass, ryegrass, annual foxtails
- Greater flexibility with application timing
- Can be used in mixed stands of fescue with bermuda, alfalfa, and other labeled species
- Resistance management

Restrictions



- Do not exceed 4.2 qt/a per year
- Do not apply to mixed stands of grasses with legumes (other than alfalfa)
- There is no pre-harvest or pre-grazing interval restriction
- Mixed stands of grasses and alfalfa may be grazed or harvested 14 or more days after applications

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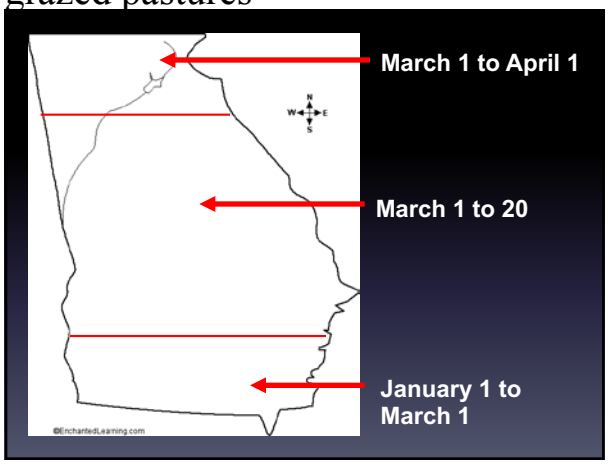
2016 Georgia Grazing School:

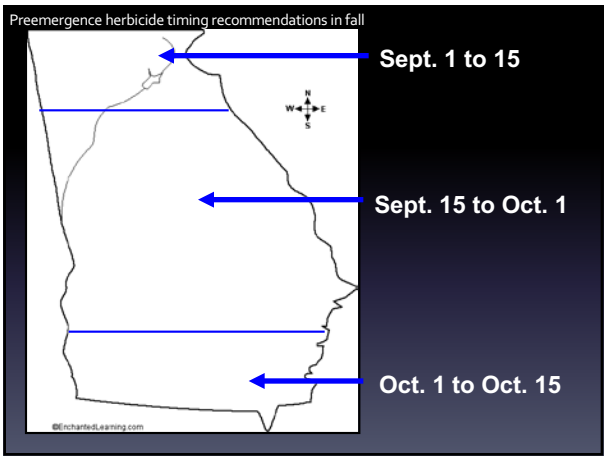
New weed management tools for grazed pastures

Dr. Patrick McCullough
Assoc. Prof. and Ext. Weed Scientist



Extending the Length of Annual Weed Control

- Apply split applications 6-8 weeks apart
  - Split in between cuttings
- For example, Prowl H_2O at 4.2 qts/acre
  - **In March**, apply 2.1 qts /acre
  - **In mid-June**, apply 2.1 qts/acre



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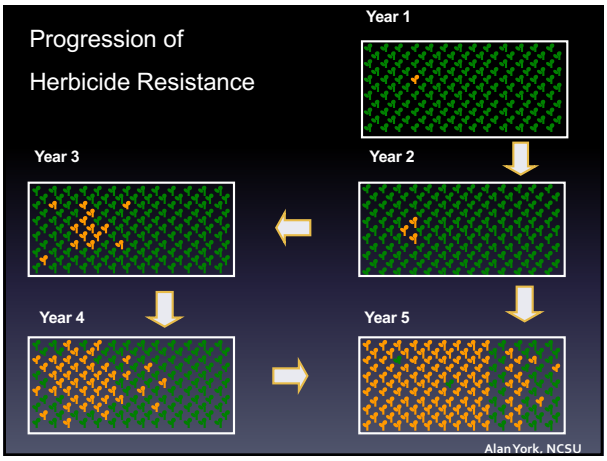

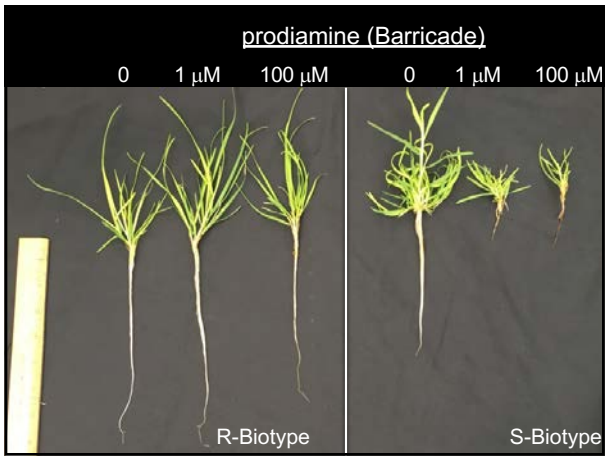

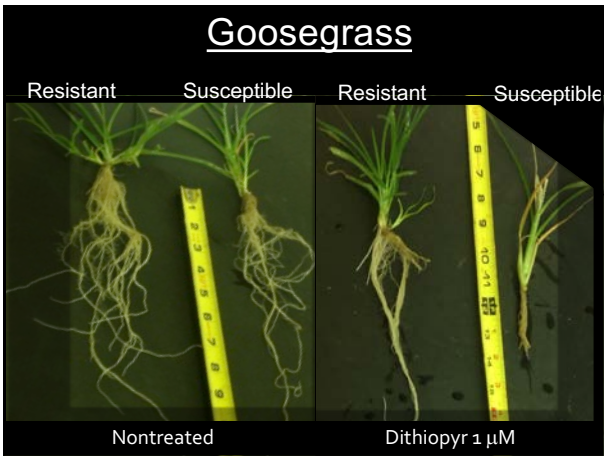

Implications for Hayfields

- Prowl or any other herbicide used exclusively is not sustainable for long-term weed management due to resistance
- Warm and cool-season grass pastures
  - Prowl H_2O is the only PRE herbicide labeled
  - Exclusive use will lead to selection pressure for resistant biotypes
- Other pasture species
  - No PRE herbicides available

Resistance Management

- Prowl H_2O can now be used to control weeds with resistance to other herbicides
  - Resistance is inevitable in tall fescue pastures
  - Must recognize that Prowl is one of many tools available
- Must use in rotation with other herbicides
  - Tank-mixtures to extend weed control
  - Bermudagrass pastures: use with Pastora, glyphosate, and other products in winter
- Tall fescue has limited selective alternatives
  - Cultural weed control (fertility, planting timing)
  - Mechanical control (mowing, seedhead suppression)

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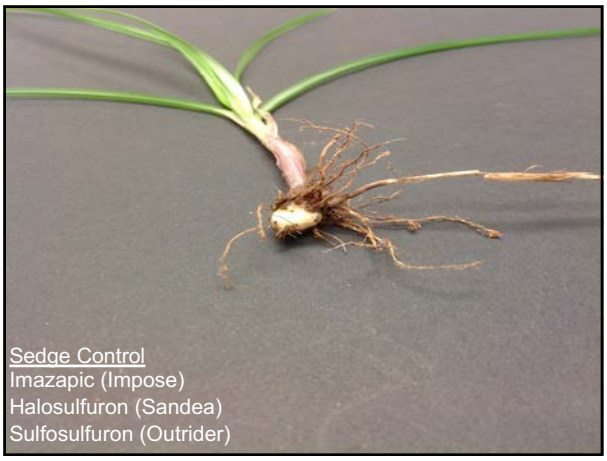

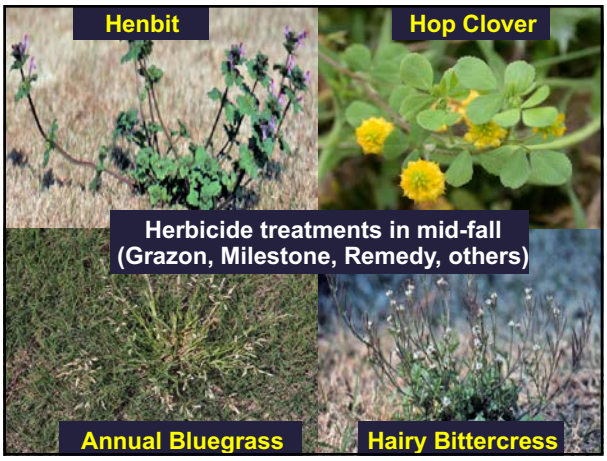

Renovation?

- Nonselective glyphosate applications in fall
  - Control toxic or perennial species
  - Example: knotroot foxtail in fescue
- Benefits
  - Plant improved varieties
  - Temporary grazing in fall
  - Enhance competition with weeds

Questions

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GRASS PASTURE AND HAY FIELD HERBICIDES

Tim R. Murphy, Extension Agronomist-Weed Science

February 2011

For many years, 2,4-D (several trade names), dicamba (Vanquish, Banvel) and 2,4-D + dicamba (WeedMaster, other trade names) were the primary herbicides used for broadleaf weed control in pastures and hay fields. While these products are still valuable components of broadleaf weed management, several new herbicides have been registered in recent years for weed control in pastures and hayfields. The following is a discussion of the characteristics and uses of these herbicides.

1. Aim – FMC

a. Two formulations: Aim EW, 1.9 lbs. carfentrazone per gallon of formulated product
Aim EC, 2.0 lbs. carfentrazone per gallon of formulated product

b. Controls seedling, annual broadleaf weeds up to 4 inches tall. Aim will not control grass weeds or sedges.

c. Add a nonionic surfactant at 0.25% v/v to the spray mix.

d. Typically, Aim is tank-mixed with other broadleaf herbicides such as 2,4-D, WeedMaster, Grazon P+D, ForeFront/GrazonNext, Milestone, Cimarron products, etc.

e. Needs a rain-free period of 6 to 8 hours.

f. There is no grazing or haying restriction for any type of livestock for Aim formulations.

2. Cimarron Max - DuPont

a. A co-pack product consisting of metsulfuron and 2,4-D + dicamba.

b. Adding metsulfuron to 2,4-D + dicamba increases number of broadleaf weed species controlled.

c. Rates - 0.25 oz. metsulfuron product plus 1.0 to 2.0 pts. 2,4-D + dicamba product per acre.

d. Apply with 0.125 to 0.25% v/v nonionic surfactant.

e. **Grazing and haying restrictions**
- No grazing restrictions for non-lactating animals
- 7 day grazing restriction for lactating dairy animals
- Remove meat animals from treated pastures 30 days before slaughter.
- Do not harvest hay for all types of livestock for 37 days after treatment.

f. Rotation intervals - same as shown for Cimarron Plus below.

g. Sprayer cleanup procedures are same as shown for Cimarron Plus below.

3. Cimarron Plus 63DF – DuPont

a. A two-way product pre-mixed product that contains 48% metsulfuron + 15% chlorsulfuron per pound of formulated product. The addition of chlorsulfuron to metsulfuron increases the number of weed species controlled.

b. Effective for 'Pensacola" bahiagrass control. Cimarron Plus has also shown excellent control of bitter sneezeweed, wild garlic/onions, curly dock, horseweed, blackberry, dewberry, buttercup, mayweed chamomile, Carolina geranium, henbit, common chickweed, wooly croton, pigweeds and thistles.

c. Rates - 0.125 to 1.25 ozs. product per acre.

d. Cimarron Plus will not control crabgrass, goosegrass, sandbur, smutgrass, 'Common' bahiagrass and 'Argentine' bahiagrass.

e. Apply with 0.125 to 0.25% v/v nonionic surfactant.

f. **There is no grazing or haying restriction for Cimarron Plus.**

g. The minimum rotation intervals after the use of Cimarron Plus at 0.25 oz. product/acre are as follows:

   a) 4 months - for overseeding with clover or alfalfa, bermudagrass, ryegrass, tall fescue.

   b) 1 month - for seeding winter or spring wheat (up to 0.375 oz/acre).

   c) 10 months - for seeding durum wheat, barley and oats (up to 0.375 oz./acre).

h. There are specific sprayer clean-up procedures which must be followed if the sprayer is to be subsequently used on other crops. This clean-up procedure is shown on the Cimarron Max label and involves the use of ammonia or spray tank cleaning solutions such as Nutra-Sol, Loveland Spray Tank Cleaner and Tank-Aid.

i. Cimarron Plus tank-mixes with liquid fertilizer are not recommended for 'Pensacola' bahiagrass control.

4. Chaparral – DowAgroSciences

a. Contains 0.62 lbs. of aminopyralid and 0.0945 lbs. metsulfuron per pound of formulated product.

b. **Recommended for use only on permanent grass pastures and hayfields.**

c. Use only on bermudagrass (established for more than 60 days) and well-established tall fescue (two years).

d. Rates – 1.5 to 3.0 ozs. product per acre.

e. Apply with 0.125 to 0.25% v/v nonionic surfactant

f. Controls numerous broadleaf weeds and ‘Pensacola’ bahiagrass.

g. Highly effective for horsenettle and tropical soda apple control.

h. No grazing or haying restriction for any type of livestock

i. Crop rotational intervals:

1. Ryegrass may be seeded at 4 months after use.

2. Do not rotate to any other crop within one year of treatment

3. Do not seed forage legumes or other broadleaf crops until a field bioassay show that the level of aminopyralid or metsulfuron in the soil will not adversely affect that forage legume or broadleaf crop. (see label).

j. Other considerations:

1. Do not transfer livestock from treated pastures, or from Chaparral treated hay feeding areas on to broadleaf crop areas without first allowing livestock to graze for 3 days on an untreated grass pasture.

2. Do not store or feed Chaparral treated hay on fields that will be planted to broadleaf crops.

3. Do not use manure from livestock grazing on Chaparral treated areas on gardens, broadleaf crops or orchards.

4. Chaparral will injure or kill legumes such as clovers and alfalfa. Do not plant legumes or broadleaf crops until a field bioassay has shown that the aminopyralid concentration in the soil is not at a level that will injure broadleaf crops (see label for instructions on conducting field bioassay).

k. There are specific sprayer clean-out procedures shown on the Chaparral label which must be followed to avoid injury to broadleaf crops. The preferred approach is to have a separate pasture sprayer.

5. <u>Crossbow - DowAgroSciences</u>

a. Contains 2.0 lbs. of 2,4-D and 1.0 lbs. of triclopyr per gallon of formulated product. This is an ester formulation and care must be used during the warm months of the year when conditions are favorable for volatilization.

b. Labeled on established forage grasses. Do not use on newly seeded or sprigged grasses until the grass has either tillered or has achieved complete soil coverage.

c. Highly injurious to interseeded legumes.

d. Effective on a wide range of woody and herbaceous broadleaf weeds. The following is a partial listing:

<u>Woody Plants</u>	<u>Herbaceous</u>
blackberry	bull thistle
black locust	buttercup
cherry	curly dock
honeysuckle	dogfennel (suppression)
multiflora rose	horseweed
sassafras	horsenettle (suppression)
sumac	musk thistle
sweetgum	willow

<u>NOTE</u>: There are additional weed species listed on the label.

e. Generally applied as a postemergence foliage application.

   Dormant stem applications are effective for multiflora rose and blackberry.

f. Use rates range from 1.0 to 4.0 qts./acre.

g. Spot treatments of a 1.5% solution (2.0 ounces of Crossbow per gallon of water) are very effective.

h. **Grazing and haying restrictions:**

   Beef cattle - Withdraw animals from treated pasture 3 days prior to slaughter.
   Horses - No grazing restriction.
   Lactating Dairy Animals - 14 days.
   Hay - Do not harvest grass for hay until the next growing season for lactating dairy animals. For other types of livestock, the haying restriction is 7 days.

h. **Reseeding Restrictions:** grasses - 21 days

6. Direx 4L (DuPont) and Diuron 4L (MANA, AgriSolutions, Loveland)

a. Both formulations contain 4.0 lbs. diuron per gallon of formulated product.

b. May be applied at 1.5 to 4.5 pts./acre immediately after sprigging of bermudagrass for preemergence control of certain annual grasses and small-seeded broadleaf weeds.

c. May also be applied postemergence at low rates (0.75 to 1.5 pts./acre + 0.125% v/v nonionic surfactant) to control small weeds that emerge during the first few weeks after bermudagrass sprigging. Bermudagrass that is emerged at time of application will be temporarily injured.

d. Sprigs should be planted 2 inches deep.

e. Not labeled for use in established forage bermudagrass.

f. Grazing restriction – 70 days

7. ForeFront and Grazon Next - DowAgroSciences

a. Both contain 0.33 lbs. aminopyralid + 2.67 lbs, 2,4-D per gallon of formulated product.

b. **Recommended for use only on permanent grass pastures and hayfields.**

c. The addition of 2,4-D to aminopyralid improves the control of plantains, wild radish and common pokeweed and certain other broadleaf weeds. This herbicide will provide excellent control of horsenettle and tropical soda apple.

d. Use rates are 1.5 to 2.6 pts./acre.

e. No grazing restriction for any type of livestock. Do not harvest forage for hay within 7 days of a ForeFront application.

f. Crop rotational intervals:

1. Do not rotate to any other crop within one year of treatment

2. Do not seed forage legumes or other broadleaf crops until a field bioassay show that the level of aminopyralid or metsulfuron in the soil will not adversely affect that forage legume or broadleaf crop (see label).

g. Other considerations:

1. Do not transfer livestock from treated pastures, or from ForeFront treated hay feeding areas on to broadleaf crop areas without first allowing livestock to graze for 3 days on an untreated grass pasture.
2. Do not store or feed ForeFront treated hay on fields that will be planted to broadleaf crops.
3. Do not use manure from livestock grazing on ForeFront treated areas on gardens, broadleaf crops or orchards.
4. ForeFront will injure or kill legumes such as clovers and alfalfa. Do not plant legumes or broadleaf crops until a field bioassay has shown that the aminopyralid concentration in the soil is not at a level that will injure broadleaf crops (see label for instructions on conducting field bioassay).

h. There are specific sprayer clean-out procedures shown on the ForeFront label which must be followed to avoid injury to broadleaf crops. The preferred approach is to have a separate pasture sprayer.

8. <u>Grazon P+D, HiredHand P+D – DowAgroSciences; GunSlinger - Albaugh</u>

a. All contain 2.0 lbs. 2,4-D amine and 0.54 lbs. picloram per gallon of formulated product. **THESE HERBICIDES ARE LABELED FOR USE ONLY ON PERMANENT GRASS PASTURES AND HAY FIELDS. THEY MAY ALSO BE APPLIED TO PERMAMENT PASTURES THAT WILL BE SEEDED WITH SMALL GRAINS OR RYEGRASS. THESE HERBICIDES ARE NOT RECOMMENDED FOR USE IN TEMPORARY SUMMER OR WINTER GRAZING SYSTEMS OR IN ROTATIONAL PROGRAMS THAT UTILIZE BROADLEAF CROPS.**

b. Controls a wide range of annual and perennial broadleaf weeds. Also provides 3 to 4 weeks residual, or preemergence, control of annual broadleaf weeds. May be used at high rate (1.0 gallon per acre) for pricklypear cactus control. It may take 2,4-D + picloram 1.5 to 2.0 years to kill pricklypear cactus.

c. Add a nonionic surfactant at 0.25% v/v.

d. Rates:

- Normal use rates are 2.0 to 4.0 pts./acre. Higher rates may be used for certain weeds such as pricklypear cactus.

e. **Grazing and haying restrictions:**

1. Lactating dairy animals - 7 days.
2. No grazing restrictions for other types of livestock.
3. Do not cut for hay (all types of livestock) for 30 days. Do not feed 2,4-D + picloram treated hay on areas that will be rotated to sensitive broadleaf (tobacco, peanuts, etc.), or use treated hay for mulching purposes. Do not use manure from animals grazing on, or hay from, 2,4-D + picloram treated areas on lands used for growing broadleaf crops.
4. Withdraw meat animals from treated forage at least 3 days before slaughter.

f. May be applied at 4.0 pts./acre or less to permanent pastures that will be seeded with cool-season grasses (ryegrass, tall fescue). Delay planting for 21 days after application.

g. Small grains should not be planted in Grazon P+D treated areas for 60 days after application.

h. Clover seeding restrictions for Grazon P+D are as follows:

   Fall-seeding is permitted if Grazon P+D at 2 pts./acre or less are applied at no later than June (4 month plant back)

   Spring (Feb. – Mar.) seeding is permitted the following spring for Grazon P+D at 2 to 3 pts./acre if applied no later than Sept. 15 the previous year.

i. May be applied to permanent pastures that have been over seeded with small grains or ryegrass. Do not apply at rates in excess of 1.5 pts./acre and until over seeded ryegrass or small grains are well-established and at the tillering stage of growth.

j. May be applied at up to 1.5 pts./acre may be applied to newly sprigged bermudagrass once the stolons (runners) have reached 6 inches in length and growing conditions are favorable.

k. There are specific sprayer clean-out procedures shown on the 2,4-D + picloram labels which must be followed to avoid injury to broadleaf crops. The preferred approach is to have a separate pasture sprayer.

l. **Other restrictions:**

   Do not rotate to grain sorghum until 8 months after application.

   Do not rotate to any food or feed crop on 2,4-D + picloram treated land if they are not registered for use with picloram until a field bioassay shows that no picloram is present in the soil.

9. <u>Gramoxone Inteon – Syngenta; Firestorm - ChemTura</u>

a. Gramoxone Inteon contains 2.0 lbs. of paraquat per gallon of formulated product. Firestorm contains 3.0 lbs. of paraquat per gallon of formulated product.

b. Labeled in dormant forage bermudagrass and for the conversion of endophyte-infected tall fescue.

c. Effective on a wide range of winter and summer annual weeds.

d. **Dormant bermudagrass** - Controls a wide range of winter annual weeds, including little barley (before mid-boot stage). Apply on warm days in Jan. - March, while bermudagrass is dormant. Do not apply during green-up.

e. Use rates: Firestorm - 0.7 to 1.3 pts./acre; Gramoxone Inteon – 1.0 to 2.0 pts./acre. A 0.25% v/v nonionic surfactant must be added to the spray mixture. A minimum spray volume of 20 to 30 gpa should be used to ensure adequate spray coverage.

f. Always use a nonionic surfactant with paraquat.

g. **Grazing and haying restrictions:**

Dormant bermudagrass -Do not pasture or mow for hay until 40 days after treatment.

Endophyte-Fescue Conversion - Do not graze the new planting for 60 days after the last application and until the new growth is at least 6 inches tall.

10. Impose – MANA (Makhtesian Agan); Panoramic - Alligare

a. Both contain 2.0 lbs. imazapic per gallon of formulated product.

b. Use only on established forage bermudagrass. Do not use on tall fescue or bahiagrass. Do not apply to newly-sprigged bermudagrass or during the grow-in period from seed or sprigs. Imazapic is not recommended for use on 'World Feeder 'or 'Jiggs' bermudagrass.

c. Do not apply during spring transition.

d. Controls crabgrass, sandbur, broadleaf signalgrass, johnsongrass, yellow and purple nutsedge, and many broadleaf weeds such as pigweed and cocklebur.

e. Can also be used to control bahiagrass..

e. Imazapic does not control knotroot foxtail, dallisgrass, goosegrass, horsenettle, pricklypear cactus, purpletop, broomsedge, hophornbeam copperleaf and bitter sneezeweed.

f. The normal application rate of imazapic for most annual grass weeds, such as crabgrass and sandbur less than 4 inches tall, is 4.0 fl. oz. product per acre. A nonionic surfactant at 0.25% v/v should be added to the spray mix, unless liquid fertilizer is used as the spray carrier (see label).

g. There are no grazing restrictions (including lactating dairy animals, horses, etc.) for Impose and Panoramic. However, there is a 7-day haying restriction for all types of livestock.

h. Impose and Panoramic is non-volatile.

i. **Studies conducted under weed-free conditions have shown that imazapic will reduce bermudagrass hay yields 20 to 50% at the first hay cut (usually 30 days)**

following an application. At a first glance the yield reduction associated with imazapic appears to be less than desirable. However, keep in mind that annual grass weeds, such as crabgrass, also reduce yield and the marketability of bermudagrass hay. Bermudagrass recovers or grows out of the injury within 20 to 30 days. No hay yield reductions have been reported for hay cuttings at 60 and 90 days after application.

11. <u>Metsulfuron – Several manufacturers</u>

a. Contains 0.6 pounds of metsulfuron per pound of formulated product. A 60 DF formulation. Formerly marketed as Ally.

b. Effective for 'Pensacola" bahiagrass control. Metsulfuron has also shown good to excellent control of bitter sneezeweed, wild garlic/onions, curly dock, horseweed, buttercup, mayweed chamomile, Carolina geranium, henbit, wooly croton, pigweeds and thistles.

c. Use only on bermudagrass (established for more than 60 days) and well-established tall fescue (two years).

d. Rates - 0.1 to 0.4 oz. product per acre.

e. Metsulfuron will not control crabgrass, goosegrass, sandbur, smutgrass, 'Common' bahiagrass and 'Argentine' bahiagrass.

f. Apply with 0.125 to 0.25% v/v nonionic surfactant.

g. **There is no grazing or haying restriction for metsulfuron.**

h. The minimum rotation intervals after the use of Metsulfuron at 0.3 oz. product/acre are as follows:

   a) 4 months - for overseeding with clover or alfalfa (0.1 to 0.3 oz./acre).
   b) 4 months - for overseeding or renovating with bermudagrass, ryegrass, tall fescue (0.1 to 0.3 oz./acre).
   c) 1 month - for seeding winter or spring wheat (0.1 to 0.3 oz./acre).
   d) 10 months - for seeding durum wheat, barley and oats (0.1 to 0.3 oz./acre).

i. There are specific sprayer clean-up procedures which must be followed if the sprayer is to be subsequently used on other crops. This clean-up procedure is shown on the Metsulfuron label and involves the use of ammonia or spray tank cleaning solutions such as Nutra-Sol, Loveland Spray Tank Cleaner and Tank-Aid.

j. Metsulfuron tank-mixes with liquid fertilizer are not recommended for 'Pensacola' bahiagrass control.

12. <u>Milestone - DowAgroSciences</u>

a. Contains 2.0 lbs. per gallon of aminopyralid.

b. **Recommended for use only on permanent grass pastures and hayfields.**

c. Controls numerous annual and broadleaf weeds. Highly effective for the control of tropical soda apple and horsenettle.

d. Normal use rates are 4.0 to 7.0 fl. ozs./acre.

e. No grazing or haying restriction for any type of livestock.

f. Crop rotational intervals:

1. Do not rotate to any other crop within one year of treatment

2. Do not seed forage legumes or other broadleaf crops until a field bioassay show that the level of aminopyralid or metsulfuron in the soil will not adversely affect that forage legume or broadleaf crop (see label).

g. Other considerations:

1. Do not transfer livestock from treated pastures, or from Milestone treated hay feeding areas on to broadleaf crop areas without first allowing livestock to graze for 3 days on an untreated grass pasture.
2. Do not store or feed Milestone treated hay on fields that will be planted to broadleaf crops.
3. Do not use manure from livestock grazing on Milestone treated areas on gardens, broadleaf crops or orchards.
4. Milestone will injure or kill legumes such as clovers and alfalfa. Do not plant legumes or broadleaf crops until a field bioassay has shown that the aminopyralid concentration in the soil is not at a level that will injure broadleaf crops (see label for instructions on conducting field bioassay).

h. There are specific sprayer clean-out procedures shown on the Milestone label which must be followed to avoid injury to broadleaf crops. The preferred approach is to have a separate pasture sprayer.

13. Outrider (formerly Maverick) - Monsanto

a. Contains 0.75 pound of sulfosulfuron per pound of formulated product.

b. Highly effective for the postemergence control of johnsongrass and nutsedge(s) and other sedges in bermudagrass and bahiagrass. Apply to emerged johnsongrass 18 to 24 inches tall up to the seedhead stage of growth. This usually occurs from May 1 to September 15 in Georgia. Applications before the boot seedhead growth stage are recommended to prevent competition.

c. Outrider will not control crabgrass, goosegrass or other grass weeds.

d. Outrider is injurious to tall fescue and other cool-season grasses.

e. Use rate is 1.33 ozs. product/acre. A nonionic surfactant (90% active ingredient) should be added at 0.25% v/v to the spray mix (2.0 pts. per 100 gallons of spray mixture). Two applications, each at 1.33 ozs./acre, at a minimum application interval of 40 days, may be used per year if johnsongrass regrowth occurs.

f. There is no grazing restriction (all types of livestock) for Outride. For best weed control do not mow or harvest two weeks before or after application.

g. Outrider will suppress bahiagrass seedhead emergence, and should not be applied to seed production fields.

h. No crop, except wheat, may be planted in Outrider treated fields within 12 months of application. There are no crop rotation restrictions for wheat

14. Pastora – DuPont

a. Contains 0.562 lbs. nicosulfuron + 0.15 lbs. metsulfuron per pound for formulated product.

b. Use rate is 1.0 to 1.5 oz. product/acre. Add a nonionic surfactant at 0.25% v/v.

c. Recommended for use only on bermudagrass that has been established for one or more years.

d. Provides postemergence control of annual grasses such as fall panicum, Texas panicum, sandbur sp., Italian ryegrass, goosegrass and crabgrass. Also, controls 'Pensacola' bahiagrass, Johnsongrass and numerous broadleaf weeds. In bermudagrass hay fields repeat applications can be used to control vaseygrass (see supplemental label at:

http://www2.dupont.com/Production_Agriculture/en_US/label_msds_info/labels/R1094.pdf

e. For best results apply to annual grasses ≤ 2 inches tall.

f. Pastora may temporarily injure or stunt bermudagrass. To minimize potential for injury, apply Pastora during bermudagrass dormancy, during spring green-up with < 2 inches of new bermudagrass growth, or within 7 days of cutting for hay. Applications at other times than those listed may decrease bermudagrass production.

g. Pastora will severely injure or kill legumes.

h. Pastora has no grazing or haying restriction for any type or livestock.

i. The minimum rotation intervals after the use of Pastora are as follows:

1) 4 months - for seeding bermudagrass, ryegrass, tall fescue and wheat

2) 10 months – for seeding barley and oats

3. 12 months – for seeding alfalfa and clovers

15. PastureGard – DowAgroSciences

a. Contains 1.5 lbs. triclopyr ester + 0.5 lbs. fluroxypyr ester per gallon of formulated product.

b. Controls a wide range of annual and perennial broadleaf weeds and numerous woody species. Provides excellent control of upright-growing blackberry at 3.0 to 8.0 pts. per acre. Also, has fair to good activity on maypop passionflower.

c. A mixture of 50% v/v PastureGard plus 50% v/v diesel fuel or kerosene may be applied for the control of most woody species with stem diameters less than 4 to 6 inches in basal diameter. Apply this mixture to the lower 12 to 18 inches of the stem

(all sides of the trunk). This same mixture can be used as a cut stump treatment. Apply basal and cut stump treatments at any time of the year except when snow or water prevents spraying to the ground line.

d. For yucca and palmetto control apply a 2.0% v/v solution. Wet the center of plant including the growing point and leaf bases to soil surface. Complete coverage of leaves is not needed.

e. PastureGard rates:

- Normal use rates for broadleaf weeds are 1.5 to 3.0 pts./acre.

f. **Grazing and haying restrictions:**

1. Lactating dairy animals – grazing is not permitted the growing season of application.
2. No grazing restrictions for other types of livestock.
3. Do not cut for hay (all types of livestock) for 14 days.
4. Withdraw meat animals from treated forage at least 3 days before slaughter.

g. **Reseeding Restrictions are as follows:**

Cool-season grasses - 21 days

Clovers and other legumes – 30 days

Only wheat, barley, oats or perennial forage grasses may be planted within 120 days of application

All other crops – 120 days

h. PastureGard may be applied to permanent pastures that have been over seeded with small grains or ryegrass. Do not apply until over seeded ryegrass or small grains are well-established and at the tillering stage of growth.

i. There are specific sprayer clean-out procedures shown on the PastureGard label which must be followed to avoid injury to broadleaf crops. The preferred approach is to have a separate pasture sprayer.

16. Prowl H_2O – BASF

a. Contains 3.8 lbs. of pendimethalin per gallon of formulated product.

b. Use rates: 3.0 to 4.2 qts./acre.

c. Controls annual grasses such as crabgrass, sandbur, goosegrass, fall panicum, Texas panicum, etc. Control of broadleaf weeds such as pigweed and lambsquarters may also occur.

d. Apply only to dormant, established bermudagrass in late winter to mid-March for preemergence control of annual grasses and certain annual broadleaf weeds.

e. Crabgrass begins to germinate when soil temperatures average 55 F. Prowl H_2O must be applied before crabgrass or other annual grasses germinate.

f. Do not apply to tall fescue, or to newly-sprigged bermudagrass.

g. Prowl H_2O may be tank-mixed with postemergence broadleaf control herbicides such Weed Master, Grazon P+D, etc. for the control of emerged broadleaf weeds.

Grazing Restriction - 60 days, all livestock types

Haying Restriction – 45 days, all livestock types

17. <u>Remedy - DowAgroSciences</u>

a. Contains 4.0 lb./gal. of triclopyr ester.

b. Triclopyr is labeled on established forage grasses. Do not use on newly seeded or sprigged grasses until the grass has established a good root system, shows good vigor and is tillering.

c. Use rates: Remedy - 1 to 2 pints /acre

d. Highly injurious to legumes.

e. Triclopyr is effective on a wide range of herbaceous plants.

Some examples are:

<u>Woody Plants</u> - blackberry, cherry, elderberry, locust, poison ivy, sassafras, sumac, willow.

<u>Herbaceous Plants</u> - clover, curly dock, common lambsquarters, plantains, vetch, thistles, and many others.

f. **Reseeding Restrictions:** grasses - 21 days

g. Applied as a postemergence foliage application. Dormant stem applications are effective on a wide range of tree and brush species. Also, a mixture of 25% v/v Remedy plus 75% v/v diesel fuel or kerosene may be applied for the control of most woody species with stem diameters less than 4 to 6 inches in basal diameter and pricklypear cactus. Apply this mixture to the lower 12 to 18 inches of the stem (all sides of the trunk). Apply basal treatments at any time of the year except when snow or water prevents spraying to the ground line.

h. Remedy may be tank mixed with 2,4-D to make a "Crossbow-type" herbicide mixture.

i. A nonionic surfactant at 0.25% v/v should be used with triclopyr.

j. Applications at air temperatures > 85 F. may cause moderate to severe bermudagrass injury for two to three weeks.

k. **<u>Grazing and haying restrictions</u>:** Same as Crossbow.

18. <u>Roundup (Monsanto)</u>

a. Roundup WeatherMax, PowerMax and Original Max contains 5.5 lb./gal glyphosate.

b. Labeled for spot and wick-bar treatments and dormant bermudagrass. Roundup PowerMax is labeled for use after the first hay cut of bermudagrass. Check the label to determine if these uses are labeled on other specific branded glyphosate products. May also be used in late summer and fall months for conversion of endophyte-infected tall fescue to non-toxic endophytic tall fescue.

c. **Application Timings**:

Dormant bermudagrass - Apply from late December to mid-March while bermudagrass is dormant for the control of Italian ryegrass, little barley and certain broadleaf weeds.

After first bermudagrass hay harvest – Apply after the first bermudagrass cutting when bermudagrass has not yet initiated regrowth for the control of annual grasses. Application made after the initiation of regrowth will damage bermudagrass.

Spot treatment - Apply anytime to control emerged annual weeds. See label for information on application timings for perennial weed control. Use a 1.0 to 2.0% v/v glyphosate/water solution

Wickbar - Apply when suitable height differential between forage grass and weeds exist. Wipe as low as possible without contacting desirable forage grass. Weeds should be "wiped" in two opposite directions. Use a 33 to 50% v/v glyphosate/water solution.

d. **Grazing and Haying Restrictions**

Dormant bermudagrass – 0 days

After first bermudagrass hay harvest – 28 days

Spot and Wickbar - 7 days

Renovations/Conversions – 0 days for rates $\leq$ 2.0 qts./acre. 56 days at rates $\geq$ 2.0 qts./acre.

19. <u>Spike 20P - DowAgroSciences</u>

a. Contains 0.2 lbs. of tebuthiuron per pound of formulated product. This herbicide has considerable activity on woody plants and extreme care must be used.

b. Effective on a wide range of woody plant species. The following is a partial listing:

oaks	cherry	black locust	maples
pines	multiflora rose	sumac	blackberry
hickory	kudzu	sweetgum	willow

<u>NOTE</u>: Numerous other woody plant species are listed on the Spike label. Spike is not effective in controlling persimmon and sassafras

c. Spike is a pelleted herbicide formulation.

d. Primarily used for spot treatment brush and tree control at the rate of 3/4ounce of product per 100 square foot of soil surface.

e. Spike will kill desirable grasses and legumes in the area where the pellet contacts the soil.

f. **Grazing and haying restrictions:**

Do not cut for hay for one year after treatment. No restriction on grazing.

20. Surmount - DowAgroSciences

a. Contains 1.19 lbs. picloram amine + 0.96 lbs. fluroxypyr ester per gallon of formulated product. **SURMOUNT IS LABELED FOR USE ONLY ON PERMANENT GRASS PASTURES AND HAY FIELDS. SURMOUNT MAY BE APPLIED TO PERMAMENT PASTURES THAT WILL BE SEEDED WITH SMALL GRAINS OR RYEGRASS. THIS PRODUCT IS NOT RECOMMENDED FOR USE IN TEMPORARY SUMMER OR WINTER GRAZING SYSTEMS OR IN ROTATIONAL PROGRAMS THAT UTILIZE BROADLEAF CROPS.**

b. Controls a wide range of annual and perennial broadleaf weeds. Also provides 3 to 4 weeks residual, or preemergence, control of annual broadleaf weeds.

Provides good control of upright-growing blackberry at 3.0 to 4.0 pts. per acre. May be used at 3.0 to 4.0 pts. per acre for pricklypear cactus control.

Complete die back of pricklypear cactus may take 2 to 3 years.

c. Add a nonionic surfactant at 0.25% v/v.

d. Surmount rates:

- Normal use rates are 1.5 to 2.0 pts./acre.

e. **Grazing and haying restrictions:**

1. Lactating dairy animals – 14 days.
2. No grazing restrictions for other types of livestock.
3. Do not cut for hay (all types of livestock) for 7 days. Do not feed Surmount treated hay on areas that will be rotated to sensitive broadleaf (tobacco, peanuts, etc.), or use treated hay for mulching purposes.
4. Withdraw meat animals from treated forage at least 3 days before slaughter.

f. **Reseeding Restrictions are as follows:**

Cool-season grasses - 21 days
Clovers and other legumes – 12 months
Grass crops are permitted within 12 months of application
All other crops - after 12 months and bioassay field

i. Surmount may be applied to permanent pastures that have been over seeded with small grains or ryegrass. Do not apply until over seeded ryegrass or small grains are well-established and at the tillering stage of growth.

j. May be applied to newly sprigged bermudagrass once the stolons (runners) have reached 6 inches in length and growing conditions are favorable.

k. There are specific sprayer clean-out procedures shown on the Surmount label which must be followed to avoid injury to broadleaf crops. The preferred approach is to have a separate pasture sprayer.

21. <u>Telar 75DF</u>

a. Contains 0.75 pounds of chlorsulfuron per pound of formulated product. A 75 DF formulation.

b. Use rates range from 0.25 to 1.0 oz. product per acre. Maximum use rate in tall fescue is 0.5 oz. product per acre.

c. Use with a nonionic surfactant at 0.25% v/v.

d. **USE ONLY IN PERMANENT GRASS PASTURES AND HAY FIELDS**. **THIS HERBICIDE IS NOT RECOMMENDED FOR USE IN ROTATIONAL PROGRAMS THAT UTILIZE GRASS OR BROADLEAF CROPS.**

e. Effectively controls many broadleaf weeds such as blackberry, pigweeds and wild radish. Not effective on common ragweed and horsenettle.

f. There is no grazing or haying restriction (all types of livestock) for Telar.

g. The minimum rotation intervals after the use of Telar is as follows:

a) 3 months - for reseeding tall fescue

h. There are specific sprayer clean-up procedures which must be followed if the sprayer is to be subsequently used on other crops. This clean-up procedure is shown on the Telar label and involves the use of ammonia or spray tank cleaning solutions such as Nutra-Sol, Loveland Spray Tank Cleaner and Tank-Aid.

22. <u>Velpar 90SP and Velpar 2L - DuPont</u>

a. Contains hexazinone.

b. Primarily is used for the control of established smutgrass. Hexazinone is root absorbed and requires about one-half inch of rainfall within two weeks of application. Applications for smutgrass control should be made in the April to July time frame. Fall applications are not highly effective.

c. Hexazinone will moderately to severely injure bermudagrass and may eliminate the first cutting of hay. Bermudagrass and bahiagrass will recover within two to four weeks of application. Not recommended for tall fescue. Bermudagrass and bahiagrass should be established for one year before treatment. Do not apply to newly seeded or newly sprigged pasture grasses.

d. Use rates: Velpar 90SP - 0.75 to 1.15 lbs. product/acre
Velpar 2L - 2.75 to 4.5 pts. product/acre.
Use low rates on sandy soils.

e. There is no grazing restriction (all types of livestock) for Velpar

f. Do not cut for hay (all types of livestock) for 38 days.

g. Hexazinone can injure trees (especially oaks). Caution should be used near desirable deciduous trees.

WEEDY GRASS CONTROL IN FORAGE GRASSES.

These are the facts for weedy grass control in forage grasses.
1. There is no labeled, selective preemergence or postemergence herbicide labeled for the control of annual grass weeds, johnsongrass and nutsedge species in fescue forage systems.
2. MSMA, Zorial, atrazine (AAtrex, other trade names) and simazine (Princep, other trade names) are not labeled on any forage grass.
3. Adequate soil fertility, especially potassium levels, must be maintained if one expects to limit the gradual build-up of annual and perennial weedy grasses. *Mydocs/pastweed11*

WEED CONTROL IN GRASS PASTURES AND HAYFIELDS

(Including bermudagrasses, bahiagrasses, fescues, and other perennial pasture grasses)

Patrick E. McCullough, Extension Agronomist-Weed Science

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
NEWLY SPRIGGED BERMUDAGRASS			
diuron Direx 4 L Diuron 4L Diuron 4L Diuron 80	 0.8-2.4 qt 0.8-2.4 qt 0.8-2.4 qt 1.0-3.0 lb	0.8-2.4 lb	Preemergence applications of diuron provide fair to good control of crabgrass, crowfootgrass and goosegrass. Also provides residual control of certain annual broadleaf weeds. Diuron should be applied immediately after sprigging before weeds emerge. Bermuda sprigs should be planted 2 inches deep to lessen chance of injury. Emerged bermuda at the time of treatment may be temporarily injured. Do not graze or feed treated foliage for 70 days after diuron application. Diuron is not labeled in established forage bermudagrass.
2,4-D Esteron 99C 4 lbs./gal. 2,4-D LV 4 Ester 2,4-D LV 6 Ester	 1.0-2.0 qts 1.0-2.0 qt 1.3-3.0 pts	1.0-2.0	Apply to emerged broadleaf weeds 3-4 inches tall. Provides poor preemergence control of crabgrass. Refer to specific herbicide label for use information.
2,4-D + *dicamba* WeedMaster 2.87 + 1.0 lb./gal.	 2.0 to 4.0 pt	0.72 + 0.25 to 1.44 + 0.5	Apply 7 to 10 days after sprigging for the postemergence control of seedling broadleaf and grass weeds. Reduced control will occur if weeds are taller than 1.0 inch, or if weed seed germination occurs 10 or more days after application. Do not graze lactating dairy animals within 7 days of application. There is no grazing restriction after an application and non-lactating animals. Do not graze meat animals in treated areas within 30 days of slaughter. Do not cut for hay within 37 days of treatment.
ESTABLISHED DORMANT BERMUDAGRASS			
paraquat Firestorm 3.0 lbs.gal. Gramoxone Inteon 2.0 lbs./gal.	 0.7-1.3 pts 1.0-2.0 pt	0.25-0.5	Apply in 20 to 30 gallons of water in late winter or early spring (probably in February or March) before bermudagrass begins spring green-up. Add 1 pt. surfactant (non-ionic) per 10 0 gal. spray mix. Do not pasture or mow for hay until 40 days after treatment.
glyphosate Roundup PowerMax Roundup Original Max Roundup Weather Max 5.5 lbs./gal.	8.0 to 11 fl oz	0.34-0.47	Apply in mid- to late-winter months to bermudagrass pastures and hayfields for the control of little barley, cheat, and to suppress Italian (annual) ryegrass. Apply before new growth appears in the spring. Bermudagrass that is not dormant at the time of application may show a slight (2 to 4 week) delay in green-up. There is no grazing or hay restriction for any type of livestock.
ESTABLISHED FORAGE GRASSES			
2,4-D (various trade names) 4 lbs./gal.	1 qt-2 qt	1.0-2.0	Apply to weeds 2 -4 inches tall. Use low rates for small weeds, high rates for larger weeds. Apply low volatile esters from October through March. Apply only non-volatile AMINE or ACID formulations from late March through September. Do not graze lactating dairy animals for 14 days after treatment, or cut for hay for all types of livestock for 30 days after treatment. (Grazing and haying restrictions may vary - refer to product label). If thistles are present, apply while they are in the rosette stage of growth.
2,4-D (mixed amines) Hi-Dep 3.8 lbs./gal.	1.0-2.0 qt	0.95-1.9	Hi-Dep consists of dimethylamine and diethanolamine salts of 2,4-D formulated for low spray volume applications. DO NOT graze dairy cattle for 7 days after application. DO NOT cut for hay for 30 days after applications.

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
ESTABLISHED FORAGE GRASSES			
dicamba Banvel 4 lbs./gal. Clarity 4 lbs./gal.	1-3 pt 1-3 pt	0.5-1.5 0.5 -1.5	Controls a wide range of broadleaf weeds. There are no grazing restrictions for animals other than lactating dairy animals. Restrict grazing for lactating dairy animals as follows: **Days Before Grazing / Days Before Hay Harvest** Up to 1 pint: 7 / 37 Up to l quart: 21 / 51 Up to 2 quarts: 40 / 70 Remove meat animals from treated areas 30 days prior to slaughter. If thistles are present, apply while they are in the rosette stage of growth. This treatment will severely injure or kill clovers and alfalfa.
carfentrazone Aim EW 1.9 lbs./gal. Aim EC 2.0 lbs./gal.	1.0-2.0 fl oz 1.0-2.0 fl oz	0.015 to 0.03 0.016 to 0.031	Controls numerous annual broadleaf weeds less than 3.0 inches tall. Carfentrazone does not control weedy grasses or sedges. Apply with a nonionic surfactant at 0.25% v/v, or a crop oil concentrate at 1.0% v/v. For most weeds, carfentrazone is tank-mixed with other registered grass pasture and hay field herbicides. Combining carfentrazone with other herbicides often increases overall control and speed of control. There are no grazing or haying restrictions for any type of livestock for carfentrazone.
2,4-D + *dicamba* Weedmaster 2.87 lbs. + 1 lb./gal. Outlaw 1.45 + 1.1 lbs./gal	2.0 pt to 4.0 pt 2.0 pt to 4.0 pt	0.72 + 0.25 to 1.44 + 0.5 0.36 + 0.27 to 0.72 + 0.55	For control of a broad spectrum of weeds, apply in late spring or early summer to annual or perennial broadleaf weeds before flowering. Do not graze lactating dairy animals within 7 days. There is no restriction between application and grazing for non-lactating animals. Do not cut for hay within 37 days after treatment. Do not graze meat animals in treated areas within 30 days of slaughter. If thistles are present, apply while they are in the rosette stage of growth. For horsenettle, use the high rate. Weedmaster and Outlaw will severely injure or kill clovers or alfalfa.
2,4-D + *picloram* Grazon P+D GunSlinger HiredHand 2 lbs. + 0.54 lb./gal.	2.0 pt to 4.0 pt	0.5 + 0.13 to 1.0 + 0.26	Controls annual and perennial broadleaf weeds. Use only in PERMANENT GRASS PASTURES AND HAYFIELDS. 2,4-D + picloram may also be applied at 4.0 pts./acre or less to permanent pastures that will be seeded with cool-season grasses (ryegrass, tall fescue). Delay planting for 21 days after application. Small grains should not be planted in treated areas for 60 days after application. For permanent pastures that have been over seeded wit h small grains or ryegrass, do not apply at rates in excess of 1.5 pts./acre and until over seeded ryegrass or small grains are well-established and at the tillering stage of growth. Clover seeding restrictions are as follows: fall-seeding is permitted if Grazon P+D at 2 pts./acre or less is applied no later than June (4 month plant back). Spring (Feb. – Mar.) seeding is permitted the following spring for Grazon P+D at 2 to 3 pts./acre if applied no later than Sept. 15 the previous year. The Gunslinger label indicates that legume establishment may not be successful if done within 12 months of application. 2,4-D + picloram may be used at 1.5 pts./acre after establishment of newly-sprigged bermudagrass once stolons have reached 6 inches in length. This herbicide is not recommended for use in rotational systems that utilize broadleaf crops or in temporary summer or winter grazing grass systems unless temporary grass is seeded into a permanent pasture. Do not graze lactating dairy animals on treated areas within 7 days after application. There are no grazing restrictions for non-lactating dairy animals, horses, sheep, goats and other types of livestock. Do not harvest grass cut for hay from treated areas for 30 days. Do not use hay from treated areas for composting or mulching of susceptible broadleaf crops. Withdraw meat animals from treated forage at least 3 days before slaughter. Do not transfer livestock from treated areas, or from 2,4-D + picloram treated hay feeding areas on to broadleaf crop areas without first allowing livestock to graze for 7 days on an untreated grass pasture. Do not store or feed 2,4-D + picloram treated hay on fields that will be planted to broadleaf crops. Do not use manure from livestock grazing on 2,4 -D + picloram treated areas on gardens, broadleaf crops or orchards. 2,4-D + picloram will injure or kill legumes such as clovers and alfalfa. Restricted Use Herbicide.

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
ESTABLISHED FORAGE GRASSES			
picloram + *fluroxypyr* Surmount 1.2 + 0.96 lb./gal.	1.5 pt to 6.0 pt	0.22 + 0.18 to 0.9 + 0.72	Controls a wide range of herbaceous and woody broadleaf plants. Use 1.5 to 2.0 pts./ acre for herbaceous broadleaf weeds. Use 3.0 to 6.0 pts./acre for woody brush and trees. Use only in PERMANENT GRASS PASTURES AND HAYFIELDS. This herbicide is not recommended for use in rotational systems that utilize broadleaf crops or in temporary summer or winter grazing grass systems unless temporary grass is seeded into a permanent pasture. Do not graze lactating dairy animals on treated areas within 14 days after application. There are no grazing restrictions for non- lactating dairy animals, horses, sheep, goats and other types of livestock. Do not harvest grass cut for hay from treated areas for 7 days. Do not use hay from treated areas for composting or mulching of susceptible broadleaf crops. Withdraw meat animals from treated forage at least 3 days before slaughter. Do not transfer livestock from treated areas, or from Surmount treated hay feeding areas on to broadleaf crop areas without first allowing livestock to graze for 7 days on an untreated grass pasture. Do not store or feed Surmount treated hay on fields that will be planted to broadleaf crops. Do not use manure from livestock grazing on Surmount treated areas on gardens, broad leaf crops or orchards. Surmount will injure or kill legumes such as clovers and alfalfa. New legume plantings may not be successful if seeded within one year of application. Restricted Use Herbicide.
triclopyr + *fluroxypyr* PastureGard 1.5 + 0.5 lbs ./gal.	1.5 to 8.0 pt	0.3 + 0.1 to 1.5 + 0.5	Controls a wide range of herbaceous and woody broadleaf plants. Use 1.5 to 3.0 pts./ acre for herbaceous broadleaf weeds. Use 2.0 to 8.0 pts./acre for woody brush and trees. Do not graze lactating dairy animals on treated areas during the same growing season following application. There are no grazing restrictions for non-lactating dairy animals, horses, sheep, goats and other types of livestock. Do not harvest grass cut for hay from treated areas for 14days. Withdraw meat animals from treated forage at least 3 days before slaughter. Legumes may be planted 30 days after application. Do not reseed forage grasses for 21 days after application.
aminopyralid Milestone 2.0 lbs./gal.	4.0 to 7.0 fl oz	0.06- 0.11	Apply to permanent grass pastures and hayfields. Controls numerous annual and perennial broadleaf weeds - particularly effective for the control of horsenettle and tropical soda apple. There are no grazing or haying restrict ions for Milestone for any type of livestock. Do not transfer livestock from treated pastures, or from Milestone treated hay feeding areas on to broad leaf crop areas without first allowing livestock to graze for 3 days on an untreated grass pasture. Do not store or feed Milestone treated hay on fields that will be planted to broadleaf crops. Do not use manure from livestock grazing on Milestone treated areas on gardens, broadleaf crops or orchards. Milestone will injure or kill legumes such as clovers and alfalfa. Do not plant legumes or broadleaf crops until a field bioassay has shown that the aminopyralid concentration in the soil is not at a level that will injure broadleaf crops (see label for instructions on conducting field bioassay).
aminopyralid + *2,4-D* ForeFront GrazonNext 0.33 + 2.6 7 lbs./gal.	1.5 to 2.6 pt	0.06 + 0.5 to 0.11 + 0.9	Apply to permanent grass pastures and hayfields. Controls numerous annual and perennial broadleaf weeds - particularly effective for the control of horsenettle and tropical soda apple. Controls a wider spectrum of weed species than Milestone. There are no grazing restrictions for ForeFront and GrazonNext for any type of livestock. Do not harvest for hay within 7 days of application (all types of livestock). Do not transfer livestock from treated pastures, or from ForeFront or GrazonNext treated hay feeding areas on to broadleaf crop areas without first allowing livestock to graze for 3 days on an untreated grass pasture. Do not store or feed ForeFront or GrazonNext treated hay on fields that will be planted to broadleaf crops. Do not use manure from livestock grazing on ForeFront or Grazon Next treated areas on gardens, broadleaf crops or orchards. ForeFront and GrazonNext will injure or kill legumes such as clovers and alfalfa. Do not plant legumes or broadleaf crops until a field bioassay has shown that the aminopyralid concentration in the soil is not at a level that will injure broadleaf crops (see label for instructions on conducting field

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
ESTABLISHED FORAGE GRASSES			
aminopyralid + *metsulfuron* Chaparral DF 0.62 + 0.0945 lb./lb.	1.5-3.0 oz	0.06 + 0.0009 to 0.12 + 0.018	Apply to permanent grass pastures and hayfields. Bermudagrass should be established for 60 days and tall fescue for two years prior to use. Apply with 0.25% v/v nonionic surfactant per 100 gal. of spray mix. Controls numerous annual and perennial broadleaf weeds - particularly effective for the control of horsenettle and tropical soda apple. Also, controls 'Pensacola' bahiagrass. Controls a wider spectrum of weed species than Milestone. There are no grazing or haying restrict ions for Chaparral for any type of livestock. Do not transfer livestock from treated pastures, or from Chaparral treated hay feeding areas on to broad leaf crop areas without firs t allowing livestock to graze for 3 days on an untreated grass pasture. Do not store or feed Chaparral treated hay on fields that will be planted to broadleaf crops. Do not use manure from livestock grazing on Chaparral treated areas on gardens, broadleaf crops or orchards. Chaparral will injure or kill legumes such as clovers and alfalfa. Do not plant legumes or broadleaf crops until a field bioassay has shown that the aminopyralid concentration in the soil is not at not at a level that will injure broadleaf crops (see label for instructions on conducting field bioassay). On tall fescue, applications in the early spring may suppress seedhead production and reduce h ay yield. To minimize injury to tall fescue; a) tank-mix 2,4-D, b) use the lowest recommended rate for the target weeds, c) use a 1/16 to 1/8% v/v surfactant concentration, d) make application s in the late spring or fall months after 5 to 6 inches of new growth has occurred, and e) do not add a surfactant when applied with liquid N.
2,4-D + *triclopyr* Crossbow 2 lbs. + 1 lb./gal.	1-6 qt		Apply to established grass pastures for control of broadleaf weeds and woody plants. Woody plant control requires 6 qts./A. or higher rate. Desirable forage broadleaf plants such as clover or alfalfa may be killed if sprayed. Grazing and haying restrictions**:** **Grazing or harvesting of green forage: (1) Lactating dairy animals** - Two gallons/acre or less; Do not graze or harvest green forage from treated area for 14 days after treatment. Greater than 2 gallons to 4 gallons/acre: Do not graze or harvest green forage until next growing season. (2) Other livestock - Two gallons/acre or less: No grazing restrictions. Greater than 2 gallons to 4 gallons/acre: Do not graze or harvest green forage from treated areas for 14 days after treatment. Note: If less than 25% of a grazed area is treated, there is no grazing restriction. **Haying (harvesting of dried forage): (1) Lactating dairy animals:** Do not harvest hay until next growing season. **(2) Other livestock:** Two gallons/acre or less: Do not harvest hay for 7 days after treatment. Greater than 2 gallons to 4 gallons/acre: Do not harvest hay for 14 days after treatment.
triclopyr + *clopyralid* Redeem 2.25 lbs. + 0. 75 lb./gal.	1.5-4.0 pt	0.38 to 1.12 + 0.14 to 0.38	Apply for control of broadleaf weeds. Use 2.5 to 4.0 pts./acre to control dogfennel, spiny amaranth and horsenettle. Desirable forage broadleaf plants such as clover or alfalfa may be killed if sprayed. Do not apply to newly-seeded or sprigged grasses until they are well established as evidenced by tillering, development of a secondary root system and vigorous growth. Grazing and haying restrictions: **Grazing or harvesting of green forage: (1) Lactating dairy animals** - Do not graze or harvest green forage from treated area for 14 days after treatment. **(2) Other livestock** - No grazing restrictions. **Haying (harvesting of dried forage): (1) Lactating dairy animals:** Do not harvest hay until next growing season. **(2) Other livestock:** Do not harvest hay for 7 days after treatment.

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
ESTABLISHED FORAGE GRASSES			
imazapic Impose Panoramic 2.0 lbs./gal	4.0-8.0 fl oz	0.063-0.125	Apply to established bermudagrass. Do not apply to other forage grass species. Provides postemergence control of crabgrass, sandbur, broadleaf signalgrass, johnsongrass, vaseygrass, nutsedge and certain other weeds. This herbicide does not control pricklypear cactus, dallisgrass and goosegrass. Apply in late spring to mid-summer after bermudagrass has reached 100% green-up growth stage. Do not apply during spring transition or to dormant bermudagrass. Imazapic is not recommended on newly-sprigged or seedling bermudagrass during the grow-in period. Research has shown that imazapic will moderately injure (yellowing of bermudagrass foliage), and suppress bermudagrass growth for approximately 20 to 40 days after application. Additionally, bermudagrass hay yields may be reduced 30 to 50% at the first hay harvest (usually 30 days) following application. Imazapic should not be applied unless a bermudagrass yield reduction is acceptable. No bermudagrass hay yield reduction has been observed at the 2nd, 3rd and 4th hay harvest following an application at 4.0 fl. ozs./acre. Add a nonionic surfactant (preferred) at 0.25% v/v or methylated seed oil at 1.5 to 2.0 pts./acre to the spray mix. The use of 2 to 3 pts./acre of 28% N, 32% N, 10-34-0 or ammonium sulfate in combination with the recommended rate of surfactant may increase control. Liquid fertilizer may be used as the sole spray carrier for imazapic, but control may be reduced. Do not add a surfactant or methylated seed oil if liquid fertilizer is used as the sole spray carrier. Annual ryegrass may be seeded 60 days after application. There is no grazing restriction for imazapic any type of livestock. Do not cut for hay for 7 days after application.
sulfosulfuron OutRider 75DF	1.33 oz	0.062	Recommended for the control of emerged johnsongrass and sedge species in bermudagrass and bahiagrass forage systems. DO NOT use OutRider on other forage grass species such as tall fescue. OutRider does not control annual grasses such as crabgrass and sandbur, or perennial grasses such as dallisgrass and vaseygrass. Apply to johnsongrass a minimum of 18 in. tall up to the heading stage. Apply to sedges 6 to 10 inches tall. Add a nonionic surfactant at 0.25% v/v. OutRider may be tank-mixed with other pasture herbicides; however, amine formulations may reduce johnsongrass control. Grazing may occur immediately before or after application; however, control may be reduced by grazing of johnsongrass foliage. For best results, do not graze or mow for two weeks before or after application.
pendimethalin Prowl H_2O 3.8 lbs./gal.	3.1-4.2 qt	3.0-4.0	Provides good preemergence control of summer annual grasses such as crabgrass and sandbur and some annual broadleaf weeds. Prowl H_2O is labeled only for established dormant bermudagrass. Applications to newly-sprigged bermudagrass, tall fescue, bahiagrass and other perennial forage grasses are not recommended. Apply Prowl H_2O to established bermudagrass in winter dormancy in the late winter and early spring. In most areas of Georgia, this would be February through early March. Crabgrass begins to germinate when soil temperatures average 55°F. Prowl H_2O must be applied before crabgrass or other annual grasses germinate. Research conducted in Georgia has shown that usually 3.0 to 4.0 lbs. ai/acre (3.1 to 4.2 quarts per acre) is needed for season-long annual grass control. Prowl H_2O may be tank-mixed with other herbicides registered for use on forage bermudagrass. Prowl H_2O should not be applied less than 45 days prior to bermudagrass hay harvest. Do not graze Prowl H_2O treated bermudagrass until 60 days after application.

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
ESTABLISHED FORAGE GRASSES			
triclopyr Remedy 4 lbs./gal.	1.0-2.0 pts.	0.5-1.0	Apply to established grass pastures for control of broadleaf weeds and brush. Triclopyr may be tank-mixed with 2,4-D for broader spectrum weed control and control of sensitive woody species. Desirable forage broadleaf plants such as clover or alfalfa may be killed if sprayed. Applications at air temperatures > 85 F. may cause moderate to severe bermudagrass injury for two to three weeks. Grazing restrictions: **Grazing or harvesting green forage: (1) Lactating dairy animals:** Two quarts/acre or less: do not graze or harvest green forage from treated areafor 14 days after treatment. **(2) Other livestock:** Two quarts/acre or less: no grazing restrictions. **Haying restriction): (1) Lactating dairy animals:** Do not harvest hay until the next growing season. **(2) Other livestock:** Two quarts /acre or less: Do not harvest hay for 7 days after treatment. **Slaughter Restrictions:** Withdraw livestock from grazing treated grass or consumption of treated hay at least 3 days before slaughter.
glyphosate Roundup PowerMax 5.5 lbs./gal. supplemental label	10 fl oz	0.43	Apply after the first bermudagrass cutting when bermudagrass has not yet initiated regrowth. Controls crabgrass, field sandbur, seedling johnsongrass and most annual grasses. Applications made after regrowth has begun will damage bermuda grass. DO NOT graze or cut for hay for 28 days after application. Make only one application per year. DO NOT make an application after the first cutting if the field has previously received a glyphosate application during the winter months.
diflufenzopyr + *dicamba* Overdrive 76.4% DF 0.2 lbs. + 0.5 lbs./gal.	4.0 oz to 8.0 oz	0.05 + 0.125 to 0.1 + 0.25	Controls annual and perennial broadleaf weeds. Add a nonionic surfactant at 0.25% v/ v or methylated seed oil at 2.0 pts./acre to the spray mix. Diflufenzopyr has been shown t o improve t he activity of "auxin-like" herbicides such as triclopyr, clopyralid and picloram. May be tank-mixed with Grazon P+D, Remedy, Redeem, 2,4-D and Cimarron to increase spectrum of weed species controlled. Overdrive is rainfast within 4 hours after application. DO NOT plant any rotational crop within 30 days of an Overdrive application. There are no grazing or haying restrictions for Overdrive for any type of livestock.
metsulfuron Metsulfuron 60EG Patriot 60DF	0.1-0.4 oz	0.004-0.015	Apply to established bermudagrass for the control of 'Pensacola' bahiagrass and certain broadleaf weeds. Bermudagrass should be established for 60 days and tall fescue for two years prior to use. Apply 1 pt.-1 qt. nonionic surfactant per 100 gal. of spray mix. On tall fescue, applications in the early spring may suppress seedhead production and reduce h ay yield. To minimize injury to tall fescue; a) tank-mix 2,4-D with metsulfuron, b) use the lowest recommended rate for the target weeds, c) use a 1/16 to 1/8% v/v surfactant concentration, d) make application s in the late spring or fall months, e) do not exceed 0.2 oz. product acre and f) do not add a surfactant when applied with liquid N. Metsulfuron tank-mixes with liquid fertilizer are not recommended for 'Pensacola' bahiagrass control. Not effective for the control of 'Common' and 'Argentine' bahiagrass. Spot treatments of metsulfuron at 1.0 oz. product per 100 gal. of water may be used for t he control of multi flora rose an d blackberry. Pasture legumes will be severely injured or killed by metsulfuron. There is no grazing or haying restriction for metsulfuron. Metsulfuron may be tank-mixed with Grazon P+D, Banvel, 2,4-D, Weedmaster, Milestone, ForeFront and Remedy or purchased as a co-pack product with 2,4-D + dicamba.

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
ESTABLISHED FORAGE GRASSES			
metsulfuron 48% + *chlorsulfuron* 15% Cimarron Plus 63 DF	0.125-1.25 oz	0.004-0.04 + 0.001-0.01	Apply to established bermudagrass for the control of 'Pensacola' bahiagrass and certain broadleaf weeds. Bermudagrass should be established for 60 days and tall fescue for two years prior to use. Apply 1 pt.-1 qt. nonionic surfactant per 100 gal. of spray mix. On tall fescue, applications in the early spring may suppress seedhead production and reduce hay yield. To minimize injury to tall fescue; a) do not use more than 0.5 oz. product/acre, b) use the lowest recommended rate for the target weeds, c) use a 1/16 to 1/8% v/v surfactant concentration, d) make applications in the late spring or fall months, e) do not exceed 0.3 oz. product/acre and f) do not add a surfactant when applied with liquid N. Cimarron Plus tank -mixes with liquid fertilizer are not recommended for 'Pensacola' bahiagrass control. Not effective for the control of 'Common' and 'Argentine' bahiagrass. Pasture legumes will be severely injured or killed by Cimarron Plus. There is no grazing or haying restriction for Cimarron Plus. Cimarron Plus may be tank-mixed with Grazon P+D, Banvel, 2,4-D, Weedmaster and Remedy.
metsulfuron 60 DF + *2,4-D* + dicamba 2.9 + 1.0 lbs./gal Cimarron Max	0.25 oz + 1.0 pt	0.009 + 0.4 + 0.125	Cimarron Max is a 2 part (co-pack) product used for annual and perennial broadleaf weed control in bermudagrass pastures. Also controls 'Pensacola' bahiagrass. Bermudagrass should be established for 60 days and tall fescue for two years prior to use. Apply 1 pt.-1 qt. nonionic surfactant per 100 gal. of spray mix. On tall fescue only, applications in the early spring may suppress seedhead production and reduce hay yield. To minimize injury to tall fescue; a) use the lowest recommended rate for the target weeds, b) use a 1/16 to 1/8% v/v surfactant concentration, c) make applications in the late spring or fall months, and d) do not add a surfactant when applied with liquid N. Cimarron Max tank-mixes with liquid fertilizer are not recommended for 'Pensacola' bahiagrass control. Not effective for the control of 'Common' and 'Argentine' bahiagrass. Pasture legumes will be severely injured or killed by Cimarron Max. There is no grazing restriction for non-lactating animals for Cimarron Max. The grazing restriction for lactating dairy animals is 7 days. Do not harvest for hay for 37 days after treatment. Remove meat animals from treated areas 30 days prior to slaughter.
Chlorsulfuron Telar 75DF	0.25-1.0 oz.	0.012-0.047	Controls many broadleaf weeds such as blackberry, pigweeds, and wild radish. Not effective for the control of horsenettle and common ragweed. May be used at rates up to 0.5 oz./acre in tall fescue. In bermudagrass and bahiagrass rates as high as 1.0 oz./acre may be used. Add a nonionic surfactant at 0.25% v/v to the spray mix. Chlorsulfuron has no grazing or haying restriction for any type of livestock.
Nicosulfuron 56.2% + *Metsulfuron* 15.0% Pastora 71.2 WDG	1.0-1.5 ozs.	0.035 to 0.053 + 0.009 to 0.014	Pastora is recommended only for use on bermudagrass that has been established for one year. Pastora can temporarily injure (yellowing, stunting) bermudagrass. Injury can be decreased by using Pastora during bermudagrass winter dormancy, during green-up with less than 2 inches of new growth and within 7 days after cutting for hay. Applications at other times may reduce bermudagrass production. Pastora is not recommended for use during bermudagrass "grow-in" from sprigs or seed. Applications to tall fescue, bahiagrass, overseeded winter annual forage grasses and other perennial forage grasses are not labeled. This herbicide has shown good to excellent control of sandbur, Texas panicum, fall panicum, broadleaf signalgrass and barnyardgrass less than 2 inches tall. Correct application timing is critical for control of annual grasses. Pastora has also shown excellent activity on Italian ryegrass, johnsongrass and 'Pensacola' bahiagrass when treated as per label directions. Pastora at 1.0 oz/acre applied twice also has good activity on vaseygrass (see supplemental label). Broadleaf weeds controlled by Pastora include bitter sneezeweed, buttercup, chickweed sp., Carolina geranium, curly dock, dogfennel, henbit, horseweed, musk thistle, smartweed sp., and wild garlic. A nonionic surfactant at 0.25% v/v is the preferred adjuvant for Pastora. This herbicide has no grazing or haying restriction for any type of livestock

USE STAGE/ HERBICIDE	BROADCAST RATE/ACRE		REMARKS AND PRECAUTIONS
	AMOUNT OF FORMULATION	POUNDS ACTIVE INGREDIENT	
POSTEMERGENCE - Spot or Wiper Applications			
glyphosate Roundup WeatherMax 5.5 lbs./gal. Roundup Original 4.0 lbs./gal.	Rate varies with species and application	Rate varies with species and application	Glyphosate may be applied in wiper applicators to weeds emerged above the forage grass, or applied as a spot treatment. Further applications may be made in the same area at 30-day intervals. Forage grasses, alfalfa, or clover coming in contact with the glyphosate will be injured or killed. Remove domestic livestock before application and wait 7 days after application before grazing livestock or harvesting. Other brands of glyphosate may also be labeled for this use.
tebuthiuron Spike 20P 20% pellet	See label.		Spike 20P pellets may be applied as a spot treatment in perennial summer grass pastures for control of individual trees or scattered stands of brush. Apply 0.75 ounce per 100 square feet of soil surface over the root systems of clump s of brush. Apply in early spring. Stands of cool season grasses such as fescue may be reduced by Spike application. Applications to or near pine trees will cause injury or death of the tree. Do not cut for hay for one year after application. Grazing is allowed after application if 20 pounds per acre or less is used.
MIXTURES - Grass-Lespedeza, Grass-Clover			
2,4-D amine 4 lbs./gal.	0.5-1 pt.	0.25-0.5	Apply only one treatment per year to perennial clovers. 2,4-D amine will cause slight to moderate injury to legumes. Refer to specific herbicide label for use information.
CONVERSION TO FUNGUS-FREE FESCUE			
paraquat Firestorm 3.0 lbs.gal. Gramoxone Inteon 2.0 lbs./gal.	0.7-1.3 pt 1.0-2.0 pt	0.25-0.5	Apply paraquat in the fall to actively-growing, endophyte-infected fescue 2 to 3 weeks prior to planting endophyte-free fescue. Apply paraquat again at planting. Apply in 20 to 40 gal. of water per acre. Always add surfactant when using paraquat. DO NOT graze the new planting for 60 days or until the new growth is 6 inches tall.
glyphosate RoundupWeatherMax Roundup Original Max Roundup PowerMax 5.5 lbs./gal.	See remarks.	See remarks.	Apply in the fall at 22 fl. ozs./A to endophyte-infected fescue 3-4 weeks prior to planting endophyte-free fescue. Tall fescue should have 6 to 12 inches of new growth before the first application. Apply again at planting at 11 fl. ozs./A. This treatment provides some suppression of common bermudagrass also. There is no waiting period between application and grazing if total application rate is less than 2.0 qt/acre. Other brands of glyphosate may also be labeled for this use.

WEED RESPONSE TO HERBICIDES USED IN PASTURE, HAY AND FORAGE CROPS

Patrick E. McCullough, Extension Agronomist – Weed Science

Not all herbicides are labeled for use on all forage crops. Refer to the recommendations shown for a specific herbicide or refer to the herbicide label.

TIME OF APPLICATION	PPI	PPI	PRE	PRE	PRE	POST	POST
	benefin (Balan)	EPTC (Eptam)	Chateau	Kerb	Prowl	2,4-D	2,4-DB
amaranth, spiny	G	G	E	P	F-G	F-G	F-G
bahiagrass	P	P	P	P	P	P	P
bermudagrass	P	P	P	P	P	P	P
bitter sneezeweed	P	P		P		E	G
blackberry	P	P		P	P	P	P
bracken fern	P	P		P	P	P	P
briars (Smilax)	P	P		P	P	P	P
broomsedge	P	P		P	P	P	P
buttercup	P	P		P	P	E	F
camphorweed	P	P		P	P	P	P
chickweed	F	E	E	G	F	P	P
crabgrass	E	G	G	F	G	P-F	
crotalaria, showy	P	P	G	P	P	G	
cudweed	P	P		P		F	
curly dock	P	P	G	P	P	F	P
dallisgrass	P	P	P	P	P	P	P
dandelion	P	E	G	P	P	E	G
dodder	P	P		E		P	P
dogbane, hemp	P	P			P	P-F	P
dogfennel	P	P		P	P	F	P
evening primrose	F	F-G	E	P		E	G
foxtails, green & yellow	G	G	F	P	F	P	P
gallberry	P	P		P	P	G	P
goldenrod	P	P		P	P	F	P

E = Excellent
G = Good
F = Fair
P = Poor Control.

A blank space indicates weed response is not known.
[1] Seedling johnsongrass only.

WEED RESPONSE TO HERBICIDES USED IN PASTURE, HAY AND FORAGE CROPS

Not all herbicides are labeled for use on all forage crops. Refer to the recommendations shown for a specific herbicide or refer to the herbicide label.

TIME OF APPLICATION	PPI	PPI	PRE	PRE	PRE	POST	POST
	benefin (Balan)	EPTC (Eptam)	Chateau	Kerb	Prowl	2,4-D	2,4-DB
henbit	F	G	E	P	F-G	P	P
honeysuckle	P	P		P	P	E	P
horsenettle	P	P		P	P	P	P
horseweed	P	P	G-E	P	P	G	P
Italian ryegrass	G	E		G		P	P
johnsongrass	G[1]	G[1]		P	G[1]	P	P
kudzu	P	P		P	P	P-F	P
Lespedeza, Sericea	P	P			P	P	P
little barley	G	G		E		P	P
maypop passion flower	P	P		P	P	P	P
mayweed				P		F	P
nettle, stinging	P	P		P	P	P	P
nutsedge	P	F	P	P	P	P	P
palmetto	P	P		P	P	P	P
perilla mint	P	P			P	P-F	
persimmon	P	P		P	P	P	P
pigweed species	G	G	E		F-G	G-E	G
plantain(s)	P	G	F	F	P	G-E	F
pokeweed, common	P	P		P	P	G	G
prickly pear	P	P		P	P	P	P
ragweed, common	P	P	G-E	P	P	E	G
red sorrel	P	P		P	P	P	P
rush species	P	P		P	P	G	P
sandbur	E	G		P	G	P	P
shepherdspurse	P	G	E	G	F	E	G
sicklepod	P	F	P	P	P	G	F
sida, arrowleaf & prickly	P	P	G-E	P	P	G	P
smartweed(s)	P	P	F	P	P	F	F

E = Excellent G = Good F = Fair P = Poor Control.	A blank space indicates weed response is not known. [1] Seedling johnsongrass only.

Not all herbicides are labeled for use on all forage crops. Refer to the recommendations shown for a specific herbicide or refer to the herbicide label.

TIME OF APPLICATION	PPI	PPI	PRE	PRE	PRE	POST	POST
	benefin (Balan)	EPTC (Eptam)	Chateau	Kerb	Prowl	2,4-D	2,4-DB
smutgrass	P	P		P	P	P	P
swinecress	P	G		F		E	F
Texas panicum	G-E	G		P	F-G	P	P
thistles	P	P		P	P	E	F
tropical soda apple	P	P		P	P	P	P
vaseygrass	P	P		P	P	P	P
vervain, blue							
Virginia pepperweed	P	G		P	P-F	G	E
wax myrtle	P	P		P	P	G	P
wild cherry	P	P		P	P	E	P
wild garlic	P	P	P	P	P	G-E	P
wild plum	P	P		P	P	E	P
wild radish	P	P-F	G-E	P	P	G	P
wild rose	P	P		P	P	G	P
wooly croton	P	P		P	P	G	P

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G = Good
F = Fair
P = Poor Control.

A blank space indicates weed response is not known.
[1] Seedling johnsongrass only.

TIME OF APPLICATION	POSTEMERGENCE							
	bromoxynil (Buctril)	Chaparral	Cimarron Max	Cimarron Plus	Crossbow	dicamba (Banvel, Clarity)	ForeFront, Grazon Next	Grazon P+D
amaranth, spiny	P	E	E	E		G-E	E	G-E
bahiagrass	P	G	F-G	G	P	P	P	P
bermudagrass	P	P	P	P	P	P	P	P
bitter sneezeweed		E	E	E	E	E	E	E
blackberry	P	G-E	F	E	G	F	P	F
bracken fern			G		G	G		F
briars (Smilax)	P				P	F		
broomsedge	P		P	P	P	P	P	P
buttercup		G-E	E	E	E	P	E	E
camphorweed		G		G			G	G-E
chickweed	F	E	E	E	F	G	G	P
crabgrass	P		P	P	P	P	P	P
crotalaria, showy		G				G	G	E
cudweed	P	G	G	G	E	E	G-E	G
curly dock		G-E	G-E	G-E	G	E	G-E	G-E
dallisgrass	P		P	P	P	P	P	P
dandelion	P				E	E	G-E	E
dodder					P	P		
dogbane, hemp		P	P	P	F-G	F	P	F
dogfennel	P	P-F	G-E	F-G	E	E	F	G-E
evening primrose		G	G	G	E	E	E	E
foxtails, green & yellow	P		P	P	P	P	P	P

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	bromoxynil (Buctril)	Chaparral	Cimarron Max	Cimarron Plus	Crossbow	dicamba (Banvel, Clarity)	ForeFront, Grazon Next	Grazon P+D
gallberry	P				E	E		
goldenrod	P	P	G-E	P	G	G	G	G
henbit	F	G-E	E	E	E	G	F	P-F
honeysuckle	P				E	E		F
horsenettle	P	G-E	F	P-F	P-F	G	E	G-E
horseweed	P	G-E	E	F	G	E	E	E
Italian ryegrass	P		P-F	P-F	P	P	P	P
johnsongrass	P		P	P	P	P	P	P
kudzu	P	G	P-F	P-F	F-G	G	G	F
lespedeza, Sericea	P	P	F-G	G-E	P-F	P		P
little barley	P				P	P		P
maypop passion flower		P	P	P			P	P-F
mayweed	P		G	G	G	E	G-E	G-E
nettle, stinging		G-E	F-G	F-G	F-G	P	G	E
nutsedge	P		P	P	P	P	P	P
palmetto	P	P	P	P		F		
perilla mint					F-G	F-G		F-G
persimmon	P				G	E		P
pigweed species	F	G-E	E	E	E	E	E	E
plantain(s)	P	G-E	E	E	G	F	G	F-G
pokeweed, common	P	P		P	G	G	G	F
prickly pear	P	P	P	P		F	P	F-G

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	bromoxynil (Buctril)	Chaparral	Cimarron Max	Cimarron Plus	Crossbow	dicamba (Banvel, Clarity)	ForeFront, Grazon Next	Grazon P+D
ragweed, common	G	G-E	G	G	E	E	E	E
red sorrel		E	G	G-E	E	G	E	
rush species	P	P	P	P	F-G	P		
sandbur	P		P	P	P	P	P	P
shepherdspurse	G				E	E	E	E
sicklepod		G	G	G	E	E	E	E
sida, arrowleaf & prickly	P		G	G	P-F	G	E	E
smartweed(s)	G	G-E	E	E	G-E	G	E	E
smutgrass	P		P	P	P	P	P	P
swinecress	E					E	E	E
Texas panicum	P			P	P	P	P	P
thistles	P	E	G-E	F-G	E	G	E	E
tropical soda apple	P	G-E	P	P	F	F-G	G-E	G-E
vaseygrass	P		P	P	P	P	P	P
vervain, blue							G	G
Virginia pepperweed	G					E	G	E
wax myrtle	P	P				E		
wild cherry	P					P	E	
wild garlic	P	G	G-E	G-E		F	F	F
wild plum	P					E	E	
wild radish	F-G	G-E	G-E	G-E	E	E	E	
wild rose	P	G	F	F	E	E	F	F
wooly croton	P	G-E	G-E	G	E	E	E	E

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	hexazinone (Velpar)	imazamox (Raptor)	imazapic (Impose)	imazethapyr (Pursuit)	metribuzin (Sencor)	Metsulfuron	Milestone	paraquat
amaranth, spiny	F-G	F-G	G	F-G	P-F	E	G	F-G
bahiagrass	P		G-E		P	G	P	P
bermudagrass	P	P	P	P	P	P	P	P
bitter sneezeweed						E	G-E	
blackberry	F				P	G	G	P
bracken fern	F					G	G	P
briars (Smilax)	F				P			P
broomsedge	P	P	P	P	P	P	P	P
buttercup	G				G	E	G-E	G
camphorweed				P		G		P
chickweed	E	G		F	E	P	F	E
crabgrass	P	F	F-G	F	F	P	P	F
crotalaria, showy								
cudweed						G	E	G
curly dock	P-F	P-F		P-F		E	E	P
dallisgrass			P		P	P	P	P
dandelion	E	F-G		P-F	G	G-E	P	G
dodder								G-E
dogbane, hemp							P	
dogfennel						P-F	P	P
evening primrose	E				G	G	E	P-F
foxtails, green & yellow	P-F	G	F-G	G	P	P	P	F
gallberry	P				P			P

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	hexazinone (Velpar)	imazamox (Raptor)	imazapic (Impose)	imazethapyr (Pursuit)	metribuzin (Sencor)	Metsulfuron	Milestone	paraquat
goldenrod						G-E	G	P
henbit	G-E	F		F	G	E	F-G	G
honeysuckle					P			P
horsenettle		P	P	P	P	P	E	P
horseweed	F	P	P	P	P	F	E	P
Italian ryegrass	G	G	F	P	P	P		G
johnsongrass	P	F	F-G	P	P	P	P	P
kudzu			P	P	P	P-F	F-G	P
lespedeza, Sericea						G-E		P
little barley	E				P	P	P	G-E
maypop passionflower		P		P	P	P	P	P
mayweed	F-G					G		E
nettle, stinging						F-G	E	
nutsedge	P	P-F	G	F	P	P	P	P
palmetto	P		P		P	P	P	P
perilla mint							P	
persimmon	F				P		P	P
pigweed species	G	G-E	G-E	G-E	G	E	E	G
plantain(s)	F-G	P		P	P	E	P	P
pokeweed, common						P	F	
prickly pear	P				P	P	P	P
ragweed, common	F	F	F	F	G	G	E	G
red sorrel						E		P-F

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	hexazinone (Velpar)	imazamox (Raptor)	imazapic (Impose)	imazethapyr (Pursuit)	metribuzin (Sencor)	Metsulfuron	Milestone	paraquat
rush species		P	P	P		P		P
sandbur			G-E		F	P	P	G
shepherdspurse	E	E	E	E	E	G	P	G
sicklepod			G		F	G	P	F-G
sida, arrowleaf & prickly		P-F		P-F	F	F	P	P
smartweed(s)	F-G	G-E		G-E		E	E	E
smutgrass	G-E	P	P	P	P	P	P	P
swinecress	E	G	E		E		P	E
Texas panicum	P		P-F		P-F	P	P	G
thistles	E	P		P	G	F	E	G
tropical soda apple	F		P		P	P	E	P
vaseygrass			F		P	P	P	P
vervain, blue							F	
Virginia pepperweed	E	G		G	G		P	G
wax myrtle	P				P			P
wild cherry	E				P			P
wild garlic					P	G	P	E
wild plum	E	P	P	P	P			P
wild radish	E	G-E	E	G-E	E	G-E	P	P
wild rose		P	P	P	P	G	F	P
wooly croton	P	P		P	P	G	E	P

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	Pastora	PastureGard	Redeem	sethoxydim (Poast)	Spike	Surmount	Triclopyr (Remedy)	Weedmaster
amaranth, spiny	G-E	P-F	P	P		G-E		E
bahiagrass		P	P	F		P	P	P
bermudagrass	P	P	P	F-G		P	P	P
bitter sneezeweed	G-E	E	E	P	E	E	E	E
blackberry		G	G-E	P	G	G	G-E	P-F
bracken fern		F	P	P	G	F	G	
briars (Smilax)		G	P	P	G	F	P	F
broomsedge	P	P	P	P		P	P	P
buttercup	E	F	E	P	G	G	E	E
camphorweed		E		P		E	E	P
chickweed	E	E	G	P	E	G-E	F	F
crabgrass	F	P	P	G-E		P	P	P
crotalaria, showy		E				E	E	G
cudweed		G	E	P		G	E	G
curly dock	G-E	F	E	P		G	E	E
dallisgrass		P	P	P		P	P	P
dandelion	G	G-E	G	P	G	E	E	E
dodder		P	P	P			P	P
dogbane, hemp		F-G	P	P		G	F	F
dogfennel	P	E	E		G	E	E	G
evening primrose	F	G		P	G	E	E	E
foxtails, green & yellow	F-G	P	P	E		P	P	P
gallberry		E	G	P			E	G

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

TIME OF APPLICATION	POSTEMERGENCE							
	Pastora	PastureGard	Redeem	sethoxydim (Poast)	Spike	Surmount	Triclopyr (Remedy)	Weedmaster
gallberry		E	G	P			E	G
goldenrod	G	G	E	P		G	G	E
henbit	E	G-E	G	P	G	G	F	P
honeysuckle		P	P	P	G	G	P	E
horsenettle	P	P-F	F	P	F	E	P-F	F
horseweed		G	G	P		E	G	E
Italian ryegrass	G-E	P	P	E		P	P	P
johnsongrass	G-E	P	P	G		P	P	P
kudzu		G	G-E	P	P	F	G-E	F
lespedeza, Sericea		E					G-E	P
little barley		P	P	F		P	P	P
maypop passion flower		F		P				P
mayweed	G-E	G	E	P	E	G-E	G	G
nettle, stinging		E	F	P		G	G-E	F
nutsedge	P	P	P	P		P	P	P
palmetto		G	P	P	F	P	F	P
perilla mint		F		P		F	F-G	F-G
persimmon		G-F	P	P		G	F	F
pigweed species	G-E	G	G	P		G	E	E
plantain(s)	F	F	P	P		F	F	G-E
pokeweed, common		P	P	P		G	P	G
prickly pear		F	P	P		E	G[2]	P

E = Excellent, G = Good, F = Fair, P = Poor Control.
A blank space indicates weed response is not known.

WEED RESPONSE TO HERBICIDES USED IN PASTURE, HAY AND FORAGE CROPS

TIME OF APPLICATION	POSTEMERGENCE							
	Pastora	**PastureGard**	**Redeem**	**sethoxydim (Poast)**	**Spike**	**Surmount**	**Triclopyr (Remedy)**	**Weedmaster**
ragweed, common		E	E	P		E	E	E
red sorrel		F	F-G	P		E	E	P-F
rush species		P	P	P		P	F	
sandbur	G-E	P	P	G		P	P	P
shepherdspurse		G	G	P	G	G	E	E
sicklepod	E	G	G	P		E	E	E
sida, arrowleaf & prickly		F	P	P		E	P	E
smartweed(s)	G			P				G
smutgrass		P	P	P		P	P	P
swinecress		G	G	P		G	G	E
Texas panicum	G-E	P	P	E		P	P	P
thistles	G	G	E	P		G-E	F-G	G
tropical soda apple	P	G	P	P	P	E	G	F
vaseygrass	F[3]	P	P	P		P	P	P
vervain, blue						E		
Virginia pepperweed		G		P			P	E
wax myrtle		G		P	F			G
wild cherry		G	F	P		G	E	E
wild garlic		F		P		P		G
wild plum		G	P	P	G	G		P
wild radish	G-E	G	F	P		E	E	E
wild rose		E	P	P	G	E	E	E
wooly croton	E	F	F	P		E	G	E

E = Excellent
G = Good
F = Fair
P = Poor Control.

A blank space indicates weed response is not known.
[2] For prickly pear cactus use 20% v/v Remedy plus 80% diesel fuel. Apply only as a spot treatment, as this treatment will severely insure desirable grasses.
[3] Apply in spring after full spring greenup of vaseygrass, or after hay harvest.

TEMPORARY SUMMER GRAZING WEED CONTROL

(Millets, sudan grass, sorghum-sudan hybrids)

Patrick E. McCullough, Extension Agronomist-Weed Science

USE STAGE AND HERBICIDE	BROADCAST RATE/ACRE: AMOUNT OF FORMULATION	BROADCAST RATE/ACRE: POUNDS ACTIVE INGREDIENT	REMARKS AND PRECAUTIONS
TEMPORARY SUMMER GRAZING CROPS-Millets, Sorghum, Sudan Hybrids, etc.			
2,4-D various trade names 4 lbs./gal.	1.0 pt	0.5	Apply to emerged broadleaf weeds when crop is 8 to 12 inches tall. Do not graze lactating dairy animals for 14 days after treatment, or cut for hay for all types of livestock for 30 days after treatment. (Grazing and haying restrictions may vary-refer to product label). Refer to specific herbicide label for use restrictions. A 2,4-D formulation labeled on millet is Formula 40.
2,4-D + *dicamba* Weedmaster 2.9 lbs. + 1 lb./gal. Outlaw 1.45 + 1.1 lbs./gal.	1.0 pt to 2.0 pt 1.0 pt to 2.0 pt	0.36 + 0.125 to 0.72 + 0.25 0.18 + 0.14 to 0.36 + 0.27	Apply to emerged broadleaf weeds when crop is 8 to 12 inches tall. Do not graze lactating dairy animals within 7 days. There is no restriction between application and grazing for non-lactating animals. Do not cut for hay within 37 days after treatment. Do not graze meat animals in treated areas within 30 days of slaughter. Weedmaster and Outlaw will severely injure or kill clovers or alfalfa.
FORAGE SORGHUM			
metolachlor Dual 8E	1.5-2.0 pt	1.5-2.0	Apply after planting seed treated with Concep or Screen seed protectant. Apply before crop and weeds emerge.
FORAGE SORGHUM AND SORGHUM-SUDAN			
atrazine 80W atrazine 4L atrazine 90DG various trade names	1.5 lb 1.2 qt 1.3 lb	1.2 1.2 1.2	Apply with 1.0 gal./A of emulsifiable oil or 1.0 qt./A of crop oil concentrate after sorghum reaches the 3-leaf growth stage but before it exceeds 12 inches in height. Controls broad leaf weeds 2 to 3 inches tall and newly-emerged (l-leaf) annual grasses. DO NOT apply with fluid fertilizers or when sorghum is under stress from cold, wet weather, poor fertility or other factors, or when sorghum is wet and tender from a recent rainfall. DO NOT graze or feed treated forage for 21 days after application.

TEMPORARY WINTER GRAZING WEED CONTROL

Patrick E. McCullough, Extension Agronomist-Weed Science

USE STAGE AND HERBICIDE	BROADCAST RATE/ACRE: AMOUNT OF FORMULATION	BROADCAST RATE/ACRE: POUNDS ACTIVE INGREDIENT	REMARKS AND PRECAUTIONS
TEMPORARY WINTER GRAZING CROPS-Small Grains, Ryegrass			
2,4-D various trade names 4 lbs./gal. *dicamba* Banvel 4.0 lbs./gal.	1 pt-1 qt 0.5 pt.	0.5-1.0 0.25	Apply in December, January or February to control swinecress, blessed thistle, wild garlic, curly dock and similar winter weeds after small grain tillering but before jointing. Grazing restrictions may vary among the different 2,4-D products. Several 2,4-D labels restrict grazing for dairy animals or meat animals being finished for slaughter for 14 days after treatment. For Banvel, restrict grazing for lactating dairy animals for 7 days after treatment and remove meat animals from treated areas 30 days prior to slaughter. For Banvel, there is no waiting period between treatment and grazing for non-lactating animals. Refer to specific herbicide label for additional use information.
2,4-D + *dicamba* Weedmaster 2.9 lbs. + 1 lb./gal. Outlaw 1.45 + 1.1 lbs./gal.	1.0 pt to 2.0 pt 1.0 pt to 2.0 pt	0.36 + 0.125 to 0.72 + 0.25 0.18 + 0.14 to 0.36 + 0.27	Apply to emerged broadleaf weeds when crop has 2 to 4 tillers. Do not graze lactating dairy animals within 7 days. There is no restriction between application and grazing for non-lactating animals. Do not cut for hay within 37 days after treatment. Do not graze meat animals in treated areas within 30 days of slaughter. Weedmaster and Outlaw will severely injure or kill clovers or alfalfa.
thifensulfuron-methyl + *tribenuron-methyl* Harmony Extra SG with TotalSol 50 SG	0.45-0.9 oz	0.0094 to 0.0188 + 0.0047 to 0.0094	Apply after two-leaf stage of wheat, barley, triticale and oats but prior to flag leaf being visible. Harmony Extra SG is not recommended for use on ryegrass or rye. Most winter annuals can be controlled with 0.45 to 0.6 oz/A; however, 0.75 to 0.9 oz/A is recommended for controlling wild garlic or small wild radish. Add 1 qt of nonionic surfactant per 100 gal of spray solution. For best results, apply when weeds are in the two- to four-leaf stage, temperatures are above 50° F, and not drought stressed. Wild garlic should be less than 12 in. tall and should have 2 to 4 in. of new growth. Liquid nitrogen may be used as the carrier. When using nitrogen as the carrier, reduce surfactant rate to 0.5 to 1.0 pint per 100 gal of solution (wheat burn may still be noted). May also tank mix Harmony Extra SG with 0.25 to 0.375 lb. ai/acre of 2,4-D or MCPA for improved control of wild radish. Do not use surfactant if Harmony Extra SG and 2,4-D or MCPA are applied in nitrogen. Do not graze within 7 days of application. This grazing restriction applies to all types of livestock. Allow at least 30 days between application and feeding of hay from treated areas to livestock.
SUPPRESSION OF BERMUDAGRASS OR BAHIAGRASS SODS			
paraquat Gramoxone Inteon 3.0 lbs./gal.	1.0-2.0 pt	0.25-0.5	Apply in early fall to sod not more than 3 inches tall, just prior to or at the time of seeding clovers or winter grasses. Add surfactant according to label directions.

Appendix

Pasture Condition Score Sheet Instructions

Pasture Condition Score Sheet

Purposes

- Evaluate current pasture productivity and the stability of its plant community, soil, and water resources.
- Identify what treatment needs, if any, are required to improve a pasture's productivity and protect soil, water, and air quality.

Suggested uses

This score sheet may be used to rate different pastures in a single growing season or the same pasture over a period of years. Rating a pasture yearly can track trends, either improvement or decline, in its condition. Some indicators change slowly in response to stresses caused by management or climate. Also, some indicators may change as each season progresses. An indicator or causative factor may rank high at one time and low another. Uniformity of use, plant residue, percent legume, severity of use, weather, and insect or disease pressure can vary widely on the same pasture depending on when they are scored during the year and the degree of management the pasture receives.

Therefore, it is often wise to score a pasture at different, key times during the year before deciding to make changes in management. Indicate on the form the date the scoring occurred.

Procedure

Step 1 - Rate each pasture one by one that is occupied all at the same time by a herd or flock and separated from other pasture areas by portable or fixed fencing. Paddocks in rotational pastures may be rated separately or as a combined unit. It depends on how alike they are. If any indicator looks markedly different from paddock to paddock, it may pay to rate each one separately.

Step 2 - Score all 10 indicators regardless of your feelings of their relative worth.

Step 3 - Using the attached score sheet and indicator criteria, read the scoring criteria for each of the 10 pasture condition indicators one at a time and rate before moving onto the next. Use the 1 to 5 scale provided. Estimate by eye or measure as precisely as you feel is needed to rate the indicator reliably.

Step 4 - When scoring plant vigor, enter a score based on the general criteria. If the plant vigor score is less than 4, refer to the plant vigor causative factors' criteria on page 2 of the scoresheet to identify the plant stress(es) causing reduced vigor. Rate each causative factor independently. Do not average to adjust the original vigor score.

Step 5 - When scoring erosion, rate sheet and rill erosion every time. Rate other types of erosion only if present.

When present, indicate which one(s) by identifying the erosion type with a unique symbol next to its score. Divide the box as needed to score them separately. Erosion is rated by averaging the individual scores. A need remains to prioritize which erosion problem is controlled first and how.

Step 6—Total the score for each pasture and compare to the following chart. Also, focus on any low scoring individual indicators or causative factors.

Overall Pasture Condition Score	Individual Indicator Score	Management Change Suggested
Greater than 46	5	Few or no changes in management needed.
36 to 45	4	Minor changes in management would enhance resource and productivity concerns.
26 to 35	3	Improvements would significantly benefit resource conservation and productivity.
16 to 25	2	Significant management changes needed to address resource and productivity concerns.
10 to 15	1	Major effort required in time, management and expenses to address resource and productivity concerns.

Step 7 - When an individual indicator's score falls below a 5, determine its worth to your operation. Then, decide whether to correct the cause or causes for the low rating. If you choose to correct, apply the most suitable management options for your area and operation.

NRCS - GEORGIA - PASTURE CONDITION SCORE - PASTURE PLANTS - FUNCTIONAL GROUPS and DESIRABILITY

Desirable Species

Functional Group 1 Cool Season Grasses
Kentucky bluegrass
Orchardgrass
Red Top
Reed Canarygrass
Rescuegrass (also call Prairie grass) "Matua"
Ryegrass, annual and perennial
Smallgrains (barley, oats, rye, triticale, wheat)
Tall Fescue
Timothy

Functional Group 2 Warm Season Grasses
Bahiagrass
Bermudagrass, hybrid or improved seed type
Bluestem, Big
Bluestem, Little
Crabgrass
Dallisgrass
Eastern gamagrass
Indiangrass
Johnsongrass
Millet, Browntop
Millet, Foxtail
Millet, Pearl
Sorghum-sudangrass hybrids
Sudangrass
Switchgrass

Functional Group 3 Legumes
Alfalfa
Clover, Crimson
Clover, Red
Clover, Subterranean
Clover, White (ladino and intermediates)
Hairy vetch
Lespedeza, Kobe
Lespedeza, Korean
Lespedeza, Sericea
Vetch, Common
Vetch, Hairy

Functional Group 4 Forbs
Brassicas (i.e. Rape, Kale, Turnips)
Chicory

Less Desirable Species

Intermediate Grasses
Barnyardgrass
Bermudagrass, common
Carpetgrass
Cheatgrass
Signalgrass, broadleaf

Intermediate Legumes
Black Medic
Clover, Hop
Clover, Rabbitsfoot
Clover, White Dutch
Florida beggarweed
Kudzu

Intermediate Forbs
Chickweed
Dandelion

Undesirable Grasses/Sedges/Rushes
Broomsedge
Foxtail, (giant, green or yellow)
Goosegrass
Little barley
Japanese stiltgrass (*Microstegium vimineum*)
Nimblewill
Nutsedge
Purpletop (*Tridens* flavus)
Rushes, most types
Sweet vernalgrass
Velvetgrass

Undesirable Forbs
Buttercup
Cocklebur
Cypress weed (dogfennel)
Dock
Henbit
Horsenettle
Marestail
Perilla mint
Plaintains
Spiny amaranth
Thistles, all types
White snakeroot

USDA United States Department of Agriculture
Natural Resources Conservation Service

Georgia Pasture Condition Score Sheet

Farm Name: **Date:**

Indicators	Pasture Number / Identification (edit as needed)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PERCENT DESIRABLE PLANTS % of plant cover by weight that is **desirable** for domestic animals using the forage: **1** <20 / **2** 20-40 / **3** 40-60 / **4** 60-80 / **5** >80															
Plant Cover - Percent live, leafy canopy cover of desirables and intermediates is: **1** <50 / **2** 50-70 / **3** 70-90 / **4** 90-95 / **5** 95-100															
PLANT DIVERSITY The diversity of **well-represented forage** species by dry matter weight is: **1** 1 dominant forage species: from one functional group; not uniformly grazed / **2** 2+ Species; from one functional group; different palatability, distributed in patches / **3** 3 + Species from one functional group; none avoided. Or two species each from different functional groups / **4** 3 + Species, 20% + Dm wt. ea from two functional groups with one being a legume / **5** 4 + Species, 20% Dm wt. ea from three functional groups. At least one legume. Intermixed well.															
PLANT RESIDUE (rate % cover and thatch thickness separately and average the scores) Ground cover of organic residue between plants & thickness of thatch (inch): **1** 0%; > 1" / **2** 1-10%; 0.5 to 1" / **3** 10-20%; <.5" / **4** 20-30%; none / **5** 30-70%; none															
PLANT VIGOR (level of potential recovery & production post graze) Degree of plant stress which affects recovery: If score <4, score the factors on second page to determine reason for poor vigor. Note plant color for nitrogen deficiencies, insect damage, and drought stress as well. **1** No recovery after grazing. Productivity < 30% of potential / **2** Slow-2+week lag. Productivity very low 30-50% of potential / **3** Moderate recovery-1 week lag. Productivity 50-75% potential / **4** Rapid-1-2 day lag. Productivity 75% - 90% potential / **5** Optimum-no lag. Productivity at site potenial															
LEGUME CONTENT Percentage of legume present as total dry weight **(cool season pasture score values above and warm season pasture score values below)**: **1** <10% or>60% / **2** 10-19% / **3** 20-29% / **4** 30-39% / **5** 40-60%															
<4% / 5-9% / 10-19% / 20-29% / 30-40%															
UNIFORMITY OF GRAZING Estimate the extent of area showing spot or patch grazing in the pasture: **1** >50% ungrazed / **2** 25-50% ungrazed / **3** 10-25% ungrazed / **4** Few patches. Minor rejection / **5** No patches only urine and dung patches ungrazed															
SEVERITY OF USE - Intensity and frequency of forage removal is: **1** Continuously below minimum height. Or ungrazed brush/weeds invading / **2** Continuously to minimum height / **3** To minimum height. Limited / Slow rotation of livestock / **4** To minimum height. Frequency based on availablity / **5** Grazed above minimum height. Frequency based on availablity															
LIVESTOCK CONCENTRATION AREAS Presence of livestock concentration areas and proximity to **surface** water: **1** >10% and/or all drain directly to water / **2** 5-10% most near water no veg. buffer / **3** <5% some near water no veg. buffer / **4** Few areas. All with veg. buffer / **5** None. Or all sited and treated to minimize impact. None near water with veg. buffer															
SOIL COMPACTION - Probe moist soil compared to an ungrazed area beneath fence **1** Very Severe / **2** Severe / **3** Moderate / **4** Slight / **5** None															
EROSION Always score Sheet & rill. Score the following when present, gully, streambank, shoreline, wind **1** Very Severe / **2** Severe / **3** Moderate / **4** Slight / **5** None Visible															
PASTURE CONDITION SCORE, total for each field															

FACTORS AFFECTING PLANT VIGOR, Used to identify causes of poor plant vigor (do not average these scores into previous page)					Pasture Number / Identification (edit as needed)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P & K Status of soil Phosphorus and potassium status of the soil is:																			
1 Near Zero or Imbalanced	**2** Severely Limiting	**3** Moderately Limiting	**4** Slightly Limiting	**5** Not Limiting															
N Status in plant tissue Nitrogen status of the plant tissue is:																			
1 Yellow-Brown	**2** Yellow-Pale Green	**3** Pale Green	**4** Pale-Natural Green	**5** Natural Green															
SOIL pH pH status of the soil for the upper 4" rooting zone best fits:																			
1 pH<4.5	**2** pH=4.5-5.0	**3** pH=5.1-5.5	**4** pH=5.6-6.0	**5** pH=6.0-7.3															
SITE ADAPTATION OF DESIRED SPECIES Long term climate and natural soil characteristics play major role in adaptation; rank site for desired species.																			
1 Very Poor	**2** Poor	**3** Good	**4** Very Good	**5** Excellent															
CLIMATIC STRESSES Degree of plant stress due to recent weather effects is:																			
1 Very Severe, dying	**2** Severe, no night recovery	**3** Moderate, mid-day stress	**4** Slight wilt or discolor	**5** None															
INSECTS & DISEASE PRESSURE Level of plant stress due to insect or disease pressure is:																			
1 Severe	**2** Threshold	**3** <Threshold	**4** Slight	**5** None															
Biological Activity Assessment (do not average these scores into previous scores)																			
EARTHWORM & DUNG BEETLE ACTIVITY This category is not an official part of PCS, but will help characterize pastures:																			
1 Poor		**3** Medium		**5** Good															
% Soil Organic Matter Record % soil organic matter values from soil tests if available (Purpose of this category is to set a monitoring baseline for future comparison as management changes):																			

General management changes based on overall score for individual pasture or whole farm.

Overall Pasture Condition Score	Individual Indicator Score	Management Change Suggested
Greater than 46	**5**	Few or no changes in management needed to address resource and productivity concerns.
36 to 45	**4**	Minor changes in management would enhance resource and productivity concerns.
26 to 35	**3**	Improvements would significantly benefit resource conservation and productivity.
16 to 25	**2**	Significant management changes needed to address resource and productivity concerns.
10 to 15	**1**	Major effort required in time, management and expenses to address resource and productivity concerns.

Authors: Dennis Cosgrove, Univ WI. Dan Undersander, Univ WI. James Cropper, NRCS.
July 2012, Modified by James T. Green, Jr., NRCS-NC. December 2015, Modified by Philip Brown NRCS - GA.

USDA United States Department of Agriculture
Natural Resources Conservation Service

Description of GA Pasture Condition Scores

Indicator	Score	Descriptor Range	Detailed Description of the Score
% Desirable Plants	1	<20%	Productive species desirable for animal use < 20 % of stand. Weedy annuals and/or brush species dominate.
	2	20-40%	Productive species desirable for animal use 20-40%stand. Mostly weedy annuals and/or brush species present and expanding.
	3	40-60%	Species desirable for animal use 40-60% stand. Undesireable broadleaf weeds and annual weedy grasses invading. Some brush species.
	4	60-80%	Species desirable for animal use 60-80% stand. Remainder mostly intermediates and a few undesirables present.
	5	>80%	Species desirable for animal use >80% stand. Scattered intermediates.
Plant Cover (Live stems and green leaf cover of all desirable and intermediate species)	1	<50%	Plant canopy cover by live stems and green leaves is < 50%; Very high potential for runoff. Photosynthetic leaf area very low.
	2	50-70%	Plant canopy cover by live stems and green leaves is 50-70%; Relatively high potential for runoff. Low photosynthetic potential.
	3	70-90%	Plant canopy cover by live stems and green leaves is 70-90%; Most forages grazed close; Moderate runoff potential. Moderate photosynthetic potential.
	4	90-95%	Plant canopy cover by live stems and green leaves is 90-95%; Some spot grazing;Very little runoff potential. Good photosynthetic potential.
	5	95-100%	Plant canopy cover by live stems and green leaves is >95-100%; Thick stand; Very slow or no runoff flows under normal rainfall intensities. Excellent photosynthetic potential.
Plant Diversity (By dry matter weight)	1	1 dominant forage species: from one functional group; not uniformly grazed	One dominant forage species making up > 75% of DM by wt. Species **not uniformly grazed.**
	2	2+ Species; from one functional group; different palatability, distributed in patches	Two + forage species making up more than 75% of DM by wt, all from one functional group. **Un-even palatability** resulting in uneven utilization and scattered patches of certain species. Species not mixed but are distributed in patches allowing for widespread avoidance or non-uniform selection by animals.
	3	3 + Species from one functional group; none avoided. Or two species each from different functional groups	3 + forage species (each 20% of DM wt.) from one functional group. **All well utilized**. Or, two forage species each from different functional group; both supply 25-50% of DM by wt.
	4	3 + Species, 20% Dm wt. ea from two functional groups with one being a legume	Three + forage species (each 20+% of DM wt.) from two functional groups with at least **one being a legume.** Well inter-mixed.
	5	4 + Species, 20% Dm wt. ea from three functional groups. At least one legume. Intermixed well	Four + forage species representing three functional groups (each making up 20+% of DM wt.) with at least **one legume.** Intermixed well.
Plant Residue (Ground cover of organic residue between plants & thickness of thatch)	1	0% Cover: > 1" thatch	No ground cover of soil surface between live plants by decaying vegetation, or thatch > 1" thick.
	2	1-10% Cover. 0.5 to 1" thick thatch	1 - 10% ground cover by vegetative organic litter in various stages of decay on soil surface between plants. Thatch 0.5 to 1" thick.
	3	10-20% Cover. < 0.5" thatch	10-20% ground cover by vegetative organic litter in various stages of decay on soil surface between plants. Thatch < 0.5".
	4	20-30% Cover. No thatch	20-30% ground cover by vegetative organic litter in various stages of decay on soil surface between plants. No thatch
	5	30-70% Cover. No thatch	>30% ground cover by vegetative organic litter in various stages of decay on soil surface between plants. No thatch

Indicator	Score	Descriptor Range	Detailed Description of the Score
Plant Vigor (Degree of stress which affects plant recovery. If <4, score the causative factors that help determine reason for poor vigor)	1	No recovery after grazing. Productivity < 30% of potential	Recovery following grazing very slow or negligible, even under favorable growing conditions. Plant leaves may be pale yellow or brown. Very few photosynthetically active leaves in canopy. Leaves may appear stressed from fertility, pests, climate or animal or insect damage. Canopy is not very competitive with undesirable species.
	2	Slow-2+week lag. Productivity very low 30-50% of potential	Recovery from grazing may take 2 or more weeks longer than normal under favorable growing conditions. Plant leaves may be yellowish green. Leaves may appear stressed from fertility, pests, climate or animal or insect damage. Productivity may be only 30-50% of site potential.
	3	Moderate recovery-1 week lag. Productivity 50-75% potential	Recovery following grazing may take 1 week longer than normal under favorable growing conditions. Plants may show minor signs of stress due to lack of fertility, climatic stress, competition from undesirable species, pests or animal damage. Plants appear reasonably healthy and photosynthetically active. Very noticeable color contrast between urine/dung patches and surrounding pasture. Productivity may be 50-75% of site potential.
	4	Rapid-1-2 day lag. Productivity 75% - 90% potential	Recovery following grazing may take 1-2 days longer than normal for healthy, vigorous plants growing under favorable conditions. 75-90% of plants appear to be turgid, have favorable color, with very minor stress from pests or fertility. Productivity is >75% of site potential.
	5	Optimum-no lag. Productivity at site potenial	Recovery following grazing is very rapid. Plants appear healthy with the natural green color for the species and weather conditions. Species appear very competitive with invading species and adapted to the site's soil and climate. Productivity would match site potential.
Legume Content (Percentage of legume present as total dry weight. **Note: Cool Season Pasture Scores / Warm Season Pasture Scores**)	1	<10 or >60% / <4%	< 10% by wt. in the mixture or greater than 60%. Warm Season Pasture (WS) <4%
	2	10-19% / 5-9%	10 to 19% by wt. in the mixture of legumes. WS Pasture 5-9%
	3	20-29% / 10-19%	20 -29% by wt in the mixture of legumes. WS Pasture 10-19%
	4	30-39% / 20-29%	30-39% by wt legumes. WS Pasture 20-29%
	5	40-60% / 30-40%	40-60% by wt legumes. WS Pasture 30-40%
Uniformity of Grazing	1	>50% of area ungrazed	"Spot" grazing (ungrazed or slightly grazed areas) is evident on more than 50% of the pasture. Mosaic grazing pattern throughout or identifiable areas have been avoided.
	2	25-50% area ungrazed	"Spot" grazed patches cover 25-50% of the pasture either in a mosaic pattern or obvious portion of pasture not grazed very often.
	3	10-25% area ungrazed	"Spot" grazed patches cover 10-25% of the pasture either in a mosaic pattern or obvious portion is not grazed often.
	4	Few patches. Minor rejection	"Spot" grazed patches cover small percentage of pasture where isolated forage types or areas have been rejected. Most ungrazed areas are surrounding urine and dung spots.
	5	No Patches. Only urnine and dung patches ungrazed	Very few forage species have been rejected. Ungrazed or under-grazed areas are directly related to urine and dung spots.
Severity of Use (intensity and frequency of forage removal)	1	Continuously below minimum height. Or ungrazed brush/weeds invading	All plants continuously grazed as close to the soil as possible and very little leaf area available. Generally less desirable species have survived this management. There is usually significant bare soil exposed. Or no grazing, resulting in thatch or accumulation of dead tissue or non desirable species invasion.
	2	Continuously to minimum height	Plants grazed to 2-3" often, resulting in thin stands and less desirable surviving plants. Pasture may resemble mown lawn look.
	3	To minimum height. Limited / Slow rotation of livestock	Spot Grazing Common. Some areas heavily utilzed; Some areas not utilized. Pasture may have patches with mown lawn look. Limited / Slow rotation of livestock.
	4	To minimum height. Frequency based on availablity	Forages are not grazed below the target height for respective species. Manager rotates livestock into area based on forage availability.
	5	Grazed above minimum height. Frequency based on availablity	Forage species grazed above desired target height for respective species. Manager rotates livestock into area based on forage availability.
Livestock Concentration Areas (% cover of livestock concentration areas and proximity to surface water)	1	>10% and/or all drain directly to water	Livestock concentration areas cover >10% of the pasture; **and/or all** drain directly into water channels.
	2	5-10% and/or most near water no veg. buffer	Livestock concentration areas cover 5-10% of pasture; **and/or most** near water channels and drain into them unbuffered by vegetation.
	3	<5% and/or some near water no veg. buffer	Livestock concentration areas cover <5% of area; **and/or some** near water channels and drain into them unbuffered by vegetation.
	4	Few areas. All with veg. buffer	Some livestock trails and one or two small lounging sites present. Not near water channels. Drainage from these areas is filtered by good vegetative buffer.
	5	None. Or all sited and treated to minimize water quality impact. None near water. All with veg. buffer.	No presence of concentration areas **or** all are sited and treated to minimize water quality impacts. None near water. Drainage from all areas filterd by good vegetative buffer.

Indicator	Score	Descriptor Range	Detailed Description of the Score
Soil Compaction (Probe moist soil with pin flag compared to an ungrazed area (i.e. beneath fence))	1	Very Severe	Excessive traffic. Pushing a pin flag wire into upper 2 inches of soil is very difficult. Infiltration capacity and surface runoff is unsatisfactory.
	2	Severe	Livestock trails common throughout. Off trail hoof prints common. It is difficult to push pin flag wire past the upper 2-4 inches of soil.
	3	Moderate	Scattered signs of livestock trails and hoof prints, mainly confined to paths to water, shade or lounging areas. Resistance to pushing a pin flag wire below 4-8 inches into the soil.
	4	Slight	Scattered signs of livestock trails and hoof prints, mainly confined to paths to water, shade or lounging areas. Almost no resistance to pin flag wire penetration into the upper 6-8 inches of soil.
	5	None	Very few signs of trails or hoof prints on bare soil. No resistance to pin flag wire penetration into soil.
Always score Sheet and Rill Erosion. Score other erosion types when present.			
Sheet and Rill	1	Very Severe	Sheet and rill erosion is active throughout pasture; rills 3-8 inches deep at close intervals and/or grazing terracettes are close-spaced with some slope slippage.
	2	Severe	Most sheet and rill erosion confined to steepest terrain of pasture; well defined rills 0.5-3 inches deep at close intervals and/or grazing terracettes present.
	3	Moderate	Most sheet and rill erosion confined to heavy use areas, especially in lounging areas & near drinking water tanks. Rills 0.5-3 inches deep. Plant / soil debris dams piled at down slope edge.
	4	Slight	No current formation of rills; some evidence of past historic rill formation but are covered with vegetation. Scattered plant / soil debris dams are present.
	5	None Visible	No evidence of current or past formation of sheet flow, rills or "soil scours".
Gully	1	Very Severe	Mass movement of soil, rock, plants, and other debris; occurrence of landslides, debris avalanches, slumps and earth-flow, creep and debris torrents.
	2	Severe	Gully(s) advancing upslope cutting longer channel(s). Revegetating difficult without using constructed structures & livestock exclusion; continuous gully(s) with many finger-like extensions into the slope.
	3	Moderate	Gully(s) present with scattered active erosion, no vegetation at heavy use slopes and/or on bed below overfalls. New eroding channels present and new overfalls appearing along sides and bed of main channel.
	4	Slight	One or more existing stable gullies present, vegetation covers gully bottom and slopes reasonably well; no visual signs of active cutting at gully head or sides. Some soil moved in channel bottom.
	5	None Visible	No gullies; natural drainage ways are stable vegetated channels. Spring or seep fed bare channels are often covered with overhanging vegetation.
Stream bank & Shoreline	1	Very Severe	Stream banks are bare and sloughing. No native vegetation remaining.
	2	Severe	Stream banks are heavily grazed and trampled. Bank sloughing and erosion is quite evident. Little native vegetation remaining.
	3	Moderate	Stream bank vegetation is grazed close but slopes not heavily trampled nor actively eroding. Some native vegetation remaining. Heavy livestock traffic at a few specific points. Remote alternative drinking water facilities may be present usually not sited well to faciltate good livestock distribution.
	4	Slight	Stream bank vegetation is grazed but slopes are stable. Mix of pasture plants, native or naturalized species along water's edge. Muddy livestock stream crossing(s) or pond entrance(s) not used heavily. Alternative drinking water facilities are present and sited to allow for good livestock distribution.
	5	None Visible	Stream bank vegetation is ungrazed or grazed infrequently. Abundant mixture of pasture plants, native or naturalized species along water's edge. Stabilized or constructed livestock stream crossing or watering ramps. Alternative drinking water facilities are used by livestock and sited to allow for good livestock distribution.
Wind	1	Very Severe	Blowouts or dunes present or being formed by wind.
	2	Severe	Soil swept from the established pasture causing plant death by burial or abrasion.
	3	Moderate	Soil swept from adjacent fields or pasture during seedbed preparation and early seedling establishment causing plant death by burial or abrasion.
	4	Slight	Some vegetative debris windrowed. Some dust deposition from offsite source. Minor wind damage to plant leaves.
	5	None Visible	No visible signs of windblown soil or litter. No wind related leaf damage.

Indicator	Score	Descriptor Range	Detailed Description of the Score
The following possible causes for poor plant vigor should be evaluated if Vigor Score < 4.			
P and K Status	1	Near zero or Imbalanced	No soil testing management; Very low P & K, or very high P & K.
	2	Severely limiting	No soil testing management; Low P and K. Confirm with soil testing.
	3	Moderately limiting	No soil testing management; Low P, optimum K; or low P, high K; or optimum P, low K; high P, low K; or high P, high K.
	4	Slightly limiting	Soil testing practiced every 3-6 years; Optimum P, high K; or high P, optimum K.
	5	Not limiting	Soil testing practiced every 2-3 yrs; Optimum P and K.
Tissue N Status	1	Yellow-Brown	Visually, leaves appear yellowish or brownish color relative to natural color for the species. Leaf tips may be brown or withering. N is deficient. However, excessive N may result in dark green appearance and potentially toxic concentrations.
	2	Yellow-Pale Green	Leaves are yellowish to pale green. Tissue testing indicates limited for optimum growth.
	3	Pale Green	Leaf tissue is pale green or slightly yellowish in color for the specific species. Moderately N deficient based on tissue testing.
	4	Pale-Natural Green	Leaf color is slightly pale but generally of the natural green color for the species.
	5	Natural Green	Leaf tissue has natural green color specific for the crop. Optimum N concentration based on tissue testing.
Soil pH	1	pH <4.5	pH < 4.5, or > 9.0 based on Soil Testing.
	2	pH 4.5-5.0	pH=4.5-5.0, or 8.5-9.0 based on Soil Testing.
	3	pH 5.1-5.5	pH=5.1-5.5, or 7.9-8.4 based on Soil Testing.
	4	pH 5.6-6.0	pH=5.6-6.0, or 7.4-7.8 based on Soil Testing.
	5	pH 6.0-7.3	pH=6.0-7.3 based on Soil Testing.
Site Adaptation [Long term climate and natural soil characteristics affect adaptation of desired species.]	1	Very Poor	Properly planted and established desired species are no longer present.
	2	Poor	Properly planted and established desired species are nearly gone. Volunteer unwanted species dominate.
	3	Good	One or more properly planted and established, or recruited desired species are missing. Unwanted species invading.
	4	Very Good	Properly planted and established, or recruited desired species still represented, but not in desired proportions
	5	Excellent	Properly planted and established, or recruited desired species are present in desired proportions
Climatic Stresses [mainly considered as recent "weather" effects]	1	Very Severe, dying	Brown and dying leaf tips due to stress from temperature (cold or hot) or moisture. Frost heaved plants, most with severed roots and dying. Major plant loss due to flooding, submergence or ice sheets. Stress may be from recent or extended weather patterns.
	2	Severe, no night recovery	Wilted plants, very little recovery during night. Or, some frost heaved plants, recovery slow. Some spotty stand loss due to flooding or ice sheets. Stress may be from recent or extended weather patterns.
	3	Moderate, mid-day stress	Wilting during heat of the day but recovery at night. Or, weak plants from winter damage or short-term submergence. Or, freezing damage to foliage. Stress may be from recent or extended weather patterns.
	4	Slight wilt or discolor	Dry conditions, but only slight wilting. Temperatures just outside the favorable range for optimum growth. Or, slight leaf yellowing due to cold, hot or wet conditions. Stress is most likely from recent weather patterns.
	5	None	No evidence of stress due to recent or long-term weather patterns.
Insects/Disease	1	Severe	Insects or diseases have consumed or damaged more than 50% of the leaf surface area.
	2	At Threshold	Insect or disease outbreak at economic threshold; treatment needed immediately.
	3	Near Threshold	Insect or disease outbreak near economic threshold, continue to watch and weigh options for treatment.
	4	Slight	Some insect and/or disease is present, but little impact on forage quality or growth rates.
	5	None	No visible signs of plant damage due to pest or diseases.
Biological Activity Assessment			
Earthworms & Dung Beetles (Not an official PCS Category but useful for soil health evaluation)	1	Poor	No evidence of worms or castings. 0-1 earthworm per per shovelful of soil taken from upper 12 inches. No dung beetle evidence. Manure paddies intact and not decomposing
	3	Medium	Scattered worm castings are found in the pasture. 2-10 earthworms per shovelful of soil taken from upper 12 inches. Some manure paddies have beetle activity.
	5	Good	Worm castings evident throughout. 10 + earthworms per shovelful of soil taken from upper 12 inches.Beetles easily found in manure. Manure paddies disintegrated in a few days.

Grazing Stick Instruction Manual

The ability to accurately estimate forage dry matter availability and animal forage dry matter demand is critical in balancing forage plant persistence and animal performance. A grazing stick is a tool that a grazing manager can use to estimate available standing dry matter. As with any tool, taking time to learn how to properly use it will increase the accuracy of the results.

A very basic first step is to understand that forage yields and animal forage demand are expressed in terms of dry matter or "dry matter basis." This simplifies calculations as moisture content of forage will vary according to season, growth stage and species. For example, a 1,100 lb dry cow has a dry matter requirement of approximately 30 lbs/day. If she is grazing a pasture that has a moisture content of 60%, to meet her dry matter demand of 30 lbs, she will consume a total volume of 50 lbs of forage. When moisture is included, this is termed "as-fed" or "as received."

Proper grazing stick use will help you better manage both forages and grazing animals.

Step 1
Determine Pounds Per Acre Inch
A direct relationship exists between inches of forage canopy height and pounds of standing dry matter (lbs/ac). This relationship varies depending on forage species and stand density (Table 1).

Table 1. Estimated Available Standing Dry Matter Pounds Per Acre Inch (lbs/ac in)

Forage	Average Good	Low-High Range
Bermudagrass	235	80-730
Fescue	160	50-265

A more complete table is found on your grazing stick. When measuring canopy height, take several measurements across the area to insure that canopy height is representative of the entire pasture. Measure to the top of the canopy. If the canopy has fallen over, straighten, but don’t stretch, the canopy to measure (Figure 1).

Figure 1.
Correct use of the grazing stick to measure canopy height.

Example: A bermudagrass canopy height of 10" and an average good value of 235 lbs/ac in would equal a dry matter availability of 2350 lbs/ac.

To reduce the variation in the range of lbs/ac and calibrate both your eye and the grazing stick, clip random, representative forage samples using a frame measuring 12" x 23". Measure canopy height where forage is clipped. Weigh and record sample weights in grams. Save a sub-sample to determine forage moisture content (see formula on back).

Use the following formulas to determine lbs/ac with a 12" x 23" frame:
Grams wet wt X % dry matter = grams dry weight
Grams dry weight X 50 = lbs/acre
lbs/ac ÷ inches canopy height = lbs/ac in

You may continue to calibrate your eye and the grazing stick throughout the growing season or until you become comfortable estimating % dry matter and stand density. At that point, simply measure canopy height and convert lbs/ac in to lbs/ac.

Step 2
Convert Total Pounds Per Acre to Available Pounds Per Acre

- Total lbs/ac X % utilization = lbs/ac of grazeable forage
- Example: 2,350 lbs/ac bermudagrass X 65% utilization = 1527 lbs/ac available for animals to consume

Percent utilization will vary according to plant species, season and management goals. Introduced forages will generally have higher utilization rates than native forages. The rule of thumb is 65 to 70% for bermudagrass and 25 to 30% for native grass.

Step 3
Determine Animal Intake (Forage Demand)

This is determined by estimating what percent of an animal's body weight it will consume in dry matter in one day. The percentage will vary according to class of animal and forage quality (Table 2). An approximate range is 2 to 4%. A value of 2.5% is most often used.

• 1,100 lb cow X 2.5% intake = 28 lbs of dry matter demand per head per day

Table 2. Grazing Formulas

$$\text{Number of Paddocks} = \frac{\text{Days of Rest}}{\text{Days of Grazing}} + 1$$

$$\text{Number of Animals} = \frac{\text{lbs/ac DM X Acres X \% utilization}}{\text{(Animal Wt X \% intake) X days}}$$

$$\text{Reserve Herd Days} = \frac{\text{lbs/ac DM X Acres X \% utilization}}{\text{(Animal Wt X \% intake) X No. Head}}$$

Dry Matter Forage Intake as a % of Body Weight

Dry Cow	2 to 3%
Lactating Cow	3 to 4%
Dairy Cow	3 to 4%
Stocker	2.5 to 3.5%
Horse	2 to 3%
Sheep and Goats	3.5 to 4%

Step 4
Putting it All Together

Grazing stick estimate of bermudagrass yield = 2,360 lbs/ac
2,360 X 65% utilization = 1527 lbs/ac available
1,100 lb cow X 2.5% intake = 28 lbs dry matter demand per day
1,527 lbs available/28 lbs demand = 54 days

Your grazing stick has helped you determine reserve herd days. In this example, one acre of bermudagrass will supply grazing for one cow for 54 days.

Determining Forage Dry Matter Using a Microwave Oven

1. Chop forage in 1" to 2" lengths.
2. Weigh out approximately 100 grams (3.5 ounces).
3. Spread forage thinly on a microwave-safe dish and place into microwave.
4. Heat for 2 minutes and reweigh.
   - If forage is not completely dry, reheat for 30 seconds and reweigh. (Microwaves vary considerably in drying capacity. It is better to dry for short intervals and reweigh until the last two weights are constant than to over-dry and run the risk of burning the forage and damaging the oven.) Continue this process until back-to-back weights are the same or charring occurs.
   - If charring occurs, use the previous weight.
5. Calculate moisture content using the formula:

$$\text{\% moisture content} = \frac{WI - W2}{WI} \text{ X } 100$$

- WI = weight of forage before heating
- W2 = weight of forage after heating
- Dry Matter (DM) is the percentage of forage that is not water
- DM equals 100% minus percent water
  Example: moisture content = 14%
  DM = 100-14 = 86%

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Using a Grazing Stick for Pasture Management

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Good management of livestock feeding enterprises requires an understanding of feed inventories and their use. Gathering this information is straightforward in grain-based feeding systems because bushels of stored grain are easily measured, and the amount fed per day is determined by the ration and the number of animals.

In pasture systems, however, keeping a forage inventory is more difficult. Feed may be allocated for more than one day, and feed quantity and quality are influenced by weather, fertility, stand density, and season. Not all of the feed available is consumed, and the plants continue to grow after they are grazed. Variation in feed quality and animal production status (pregnant, dry, lactating, growing, etc.) may also influence feed consumption.

This publication is intended to help producers meet animal forage needs in a rotational grazing system by mastering the use of a grazing stick to estimate pasture yield and pasture allocation.

Grazing sticks are useful for making immediate pasture management decisions, but good records of pasture yield, grazing days, and other data will provide a means to evaluate past efforts. Grazing sticks look like a simple measuring device, but are really a measurement system. They include a ruler for measurement, grazing guidelines, and conversion formulas for making immediate pasture management decisions. Grazing sticks are handy tools that simplify measuring pasture yield, allocating pasture to animals, and tracking productivity changes. These tasks are all critical aspects of good pasture management.

Grazing sticks vary somewhat from state to state. The Kentucky model consists of the following, shown on the stick itself:

- A ruler to measure forage height
- A quick guide to start and stop grazing on a paddock
- A table to convert stand density to dry matter per acre-inch
- Formulas for pasture allocation and management decisions
- General guidelines and planning information

Using the Grazing Stick

Yield Estimation

Keep in mind the estimate is only as good as the sample. If the forage stand and the topography are uniform, a minimum of one sample per acre is recommended. Take more measurements for fields with variable soils, topography, or forage stands.

Figure 1. Ruler used to measure height.

Step 1—Use the ruler to measure forage height (Figure 1). With most forages, plant height taller than 18-24 inches is really better suited to hay than to grazing. This is particularly true with endophyte-infected tall fescue, because toxins increase with stem growth and seed head development. See *Sampling Tall Fescue Endophyte in Pasture or Hay Stands* (PPA-30) for more information on dealing with infected tall fescue.

Height is not a measure, but rather an average, of the tallest plants. Spread your hand and lower it onto the canopy. The average height is measured at the point where you feel very modest resistance from the plant canopy. In Figure 1, the height is 7 inches. Record the height for each sample location in the pasture and then calculate the average height for the pasture.

Step 2—Stand density is the amount of the ground surface covered with standing forage. Your goal is to place the pasture into one of three density categories (less than 75%, 75 to 90%, or more than 90%).

Visually estimate stand density by looking directly down at each location where you have just measured canopy height. Do not include ground residue, only plant material tall enough for the livestock to consume. Stand density measurements using the grazing stick are most accurate when canopy height is approximately 8 inches.

Record the density reading for each location, then calculate the average stand density for the pasture. The density yield table (Table 1) can now be used to estimate forage yield per acre-inch. The table is more accurate with denser stands.

Step 3—Determine the dry matter (DM) yield per acre-inch using the density measured in Step 2. For example, if you are measuring a tall fescue pasture and you estimate that the available forage covers 85% of the ground area, this pasture would be assigned to the middle density category of 75 to 90% cover. According to Table 1, this density rating would be between 150 and 200 lb of DM per acre-inch. Based on your assessment of the stand, assign a yield. The thicker the stand, the closer the yield will be to the upper end of the range. Since 85% is in the upper end of this density category, 200 lb of DM per acre-inch would be a good estimate. If the average stand height is 8 inches and you want to maintain 3 inches of stubble after grazing, available forage equals:

5 inches x 200 lb/acre-inch = 1,000 lb DM/acre.

Step 4a—Calibration (quick estimate): A periodic check of your measurements can help you be consistent in using the grazing stick. Harvest 1 square foot of forage (cut at soil level), weigh it in grams, and multiply it by 20. This calculation will give an estimate of lb per acre assuming the forage is 20% DM. While this method is useful for a quick check, the DM content of forage does vary throughout the year, so the yield estimate will be more accurate if the sample is actually dried.

Step 4b—Calibration (better estimate):

1. Harvest 1 square foot of forage (cut at soil level) and chop the forage into 1- to 2-inch lengths.
2. Weigh the forage (in grams) then place it on a microwave-safe dish. Place the dish in a microwave oven along with a cup of water, which helps reduce the risk of burning the forage.
3. Heat on high for two minutes.
4. Weigh the forage.
5. If the forage is not dry, place it back in the oven and heat it for 30 seconds more.
6. Repeat steps D and E until the weight does not change. If the forage is charred, use the last weight.
7. Multiply the dry weight in grams by 100 for an estimate of dry matter yield in lb per acre.

Table 1. Estimated dry matter yield per acre inch based on density and forage type.

	Density		
	<75%	75-90%	>90%
Forage	**Dry Matter Yield (lb)**		
Tall fescue or orchardgrass	50-150	150-200	200-300
KY Bluegrass	50-100	100-175	175-250
Cool-season grass (clover)	50-125	125-200	200-275
Bermudagrass	100-200	200-300	300-400
Alfalfa	75-150	150-225	225-300
Red clover	75-125	125-175	175-250

Allocate Forage

Your pasture system will determine how you apportion forage for your animals. If you are using temporary electric fencing and allocating acreage to feed your animals for a specific number of days, you will need to calculate the acres needed per day. If you have a slow rotation with modest-sized paddocks, you will have to determine how many days a particular paddock will carry your herd. If you can vary animal numbers to fully utilize your available pasture, you will have to determine how many animals are required. Each situation will require you to estimate yield and to make the appropriate allocation. In addition to forage yield, the formulas for calculating pasture allocation require values for percent utilization (Table 2), animal weights, and animal intake (Table 3).

Table 2. Percent utilization of available forage based on grazing system.

System	Utilization
Continuous	30-40%
Slow rotation (3-4 paddocks)	40-55%
Fast rotation (8+ paddocks)	55-70%

Source: The Kentucky Grazing Stick.

Table 3. Forage intake guidelines.

Livestock Class	Dry Matter Intake as Percent of Body Weight
Dry beef cow	2
Lactating beef cow	3-4
Lactating dairy cow	2.5-5*
Stockers	2.5-3.5
Horses	2.5-3
Sheep & Goats	3.5-4

*May include grain.

Utilization is defined as the percent of the available forage that animals consume. Utilization rates vary with the intensity of the grazing system (Table 2).

Animals will only use 30-40% of the forage on a continuously grazed pasture because they have excess forage and graze selectively. The forage they do not eat may become mature and unpalatable. In addition, much of the available forage becomes waste because it is trampled or fouled with dung or urine.

With pasture rotation, the grazing period is shortened, animals cannot be as selective, and less forage is wasted (Table 2). With a slow rotation (three to four paddocks, animals moved every seven to 10 days), the utilization increases to 40-55%. A faster rotation will increase utilization to 55-70%. It is possible to achieve higher utilization (70-80%) with intensive rotational systems (animals moved once or twice a day).

Livestock species, class, and physiological condition all have profound effects on intake (Table 3). Forage intake may also be influenced by the stage of plant growth. Mature plants are a low-quality feed because they have high fiber content. Fiber digests slowly and limits the amount an animal can consume. See American Farm Bureau publication *Understanding Forage Quality* (pub. no. 1-01) for more detailed information. Lactating dairy cows need a high level of nutrition to maintain high levels of milk production and, as indicated in Table 3, some supplementation with grain may be necessary to provide sufficient intake for these animals.

Pasture Allocation Examples Using Formulas from the Grazing Stick

Calculate: The paddock size needed to feed a set number of animals.

Example 1: 100 dry cows, average weight 1,350 lb.

$$\text{Acres required/paddock} = \frac{\text{(weight) x (intake in \% body weight) x (animal \#) x (days/paddock)}}{\text{(available DM/acre) x (\% utilization)}}$$

Step 1—Animals will be moved every three to five days in an eight-paddock system, so utilization is estimated to be 60% (Table 2).

Step 2—Set intake—because they are dry cows, use 2% (Table 3).

$$\frac{\text{(1,350 lb/cow) x (0.02/day) x (100 cows) x (4 days)}}{\text{(1,000 lb/acre) x (.60)}}$$

= 18 acres

Calculate: The number of animals needed to utilize the available forage.

Example 2: The paddock size is 20 acres and the grazing period is 4 days.

$$\text{\# of animals required to graze a paddock} = \frac{\text{(DM/acre) x (acres) x (\% utilization)}}{\text{(animal weight) x (intake in \% body weight) x (days)}}$$

$$\frac{\text{(1,000 lb/acre) x (20 acres) x (.60)}}{\text{(1,350 lb) x (0.02/day) x (4 days)}}$$

= 111 cows would be needed to graze these pastures down in 4 days.

Calculate: The number of days a paddock will last.

Example 3: A herd of 100 cows on a fast rotation.

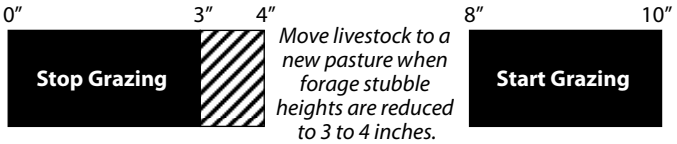
$$\text{Days of grazing per paddock} = \frac{\text{(DM/acre) x (acres) x (\% utilization)}}{\text{(animal weight) x (intake in \% body weight) x (\# animals)}}$$

$$\frac{\text{1,000 lb/acre x 20 acres x .60}}{\text{1,350 lb x 0.02/day x 100 cows}}$$

= 4.4 days

The grazing stick also has a quick guide (Figure 2). If you carry the stick with you whenever you check animals or move fences, you can quickly assess pasture regrowth and readiness for grazing. The suggested starting height for grazing cool-season grasses is 8 to 10 inches, which ensures that forage is in a high-quality vegetative stage. The stop-grazing limit applies to grass or grass-legume pastures. The 3- to 4-inch stubble height ensures that some leaf tissue is available for grass regrowth. Removal of basal leaves will slow grass regrowth and limit yield. If pastures are growing quickly in the spring, you may need to harvest or clip them to keep them productive and in high-quality condition.

Figure 2. Quick grazing guide.



The guidelines for grazing vary according to the plant species (Table 4). For example, grazing is normally delayed until bud stage for alfalfa so that the plants can restore root reserves that were used in regrowth. Consistently grazing forages before the indicated height or stage may thin the stand. Overgrazing so that too little stubble remains after grazing may limit pasture yield because the plants will not have enough leaf tissue for photosynthesis and rapid growth. Rest periods and forage removal must be carefully balanced to keep pastures productive. One of the best ways to achieve this balance is by frequently observing pastures and the amount of pasture regrowth. In spring, pasture growth is often too rapid for optimum grazing, so rotations may need to be accelerated to maintain good pasture quality. In summer, cool-season plants grow more slowly, and the rotations may need to be slowed to allow full recovery from grazing. When planning grazing systems, you can calculate the number of paddocks necessary to provide a desired rest period.

$$\text{Number of paddocks} = \frac{\text{(days of rest)}}{\text{(days of grazing)}} + 1$$

Table 4. Guidelines for Optimum Grazing Height (in inches).

Forage	At Beginning of Grazing	At End of Grazing
Cool-season grasses and legumes other than alfalfa	8-10	3-4
Alfalfa	Bud stage	2-3
Annual warm-season grasses	20-24	8-10
Native warm-season grasses	18-22	8-10
Bermudagrass	6-8	1-2

Good Record Keeping

You'll find the grazing stick a handy tool, but keep in mind that it provides only an estimate of pasture yield. You can improve your grazing system with good records of pasture yield, grazing days, and other data because they allow you to evaluate past efforts. If you keep good records and compare yield estimates with data from actual grazing days, you will be able to more closely calculate the actual yield for your farm and your conditions.

Grain producers determine the number of inputs to use based on the yield they will gain from each one. Because inputs and the resulting yield are easily measured, grain production systems can be quickly refined and improved. Good pasture records are slightly more difficult to collect, but they can also contribute to rapid improvement of pasture systems. One objective of pasture improvement is to increase yield, but changes in pasture management may also target herbage quality, yield distribution, or persistence. Pasture improvement may result in improved gains, increased carrying capacity, or reduced need for supplementation during summer months. Records help a manager place a value on improvements and make decisions on where to spend limited resources to maximize the benefits. These improvements are not necessarily obvious unless producers keep good records and study them.

More specific information about grazing, pasture management, and forage species is available in UK Cooperative Extension publications such as *Rotational Grazing* (ID-143). A list of recommended publications is included at the end of this document.

All your record information should be entered in a timely manner and regularly reviewed. It should include record year, paddock identification, paddock size, monthly rainfall, date and amounts of fertilizer, seed and pesticide inputs, and the most recent soil test data. In addition, each time a paddock is grazed, record the number and average size of animals, dates in and out, pasture height at the beginning and end of grazing, and yield estimate and stand density at the start of grazing.

Using Your Records for Planning

Records must be studied. Some people diligently keep records and file them at the end of the season. It will take some work to compile records into a form that you can use efficiently, but this effort is worthwhile. If you are going to keep records, commit yourself to using them.

Here are a few questions that might be answered by studying your pasture records:

- How much did legumes increase animal grazing days per acre during the summer?
- How much did fertilizer improve animal grazing days per acre?
- Which pastures and forages performed best in a dry year?
- How severe is the summer slump? Do you need to increase production during this period?
- Are your pastures improving or declining? Do you need to increase or decrease stock density to improve your pastures?
- Did your stockpile run out before spring growth began? How many more acres of stockpile do you need to support the herd? Can you fill gaps in forage production by grazing crop residues?
- Did your pasture management improvements result in reduced costs, increased carrying capacity, or better gains?

The following is a selection of the publications on forages and grazing available online at www.uky.edu/Ag/Forage/ForagePublications.htm or from your extension agent.

AGR-59—*Tall Fescue*
AGR-85—*Efficient Pasture Systems*
AGR-108—*Tall Fescue in Kentucky*
AGR-119—*Alternatives for Fungus Infected Tall Fescue*
AGR-162—*Stockpiling for Fall and Winter Pasture*
AGR-175—*Forage Identification and Use Guide*
ID-74—*Planning Fencing Systems for Intensive Grazing Management*
ID-97—*Grazing Alfalfa*
ID-143—*Rotational Grazing*
AE 2005-04—*The Economics of Renovating Pastures with Clover*
AE 2005-05—*The Economics of Using Improved Red Clover Varieties*
AE 2005-06—*The Economics of Pasture Fertilization*
PPA-30—*Sampling for the Tall Fescue Endophyte in Pasture or Hay Stands*
Tall Fescue Endophyte Concepts—Don Ball et al., 2003, Oregon Tall Fescue Commission, Spec. pub. No. 1-03
Understanding Forage Quality—Don Ball et al., 2001, American Farm Bureau pub. No. 1-01

Additional Useful References

Ball, D.M, C.S. Hoveland, and G.D. Lacefield. 2002. Southern Forages. 3rd ed., Potash and Phosphate Institute, Norcross, GA 30092.

Determining Forage Moisture Content Using a Microwave Oven

Revised 5-2010

Meeting Evaluation:
2016 Georgia Grazing School

Return to Dr. Dennis Hancock, Extension Forage Agronomist

Overall, how helpful was this meeting? (Check ONE).

- ☐ I plan to make some major changes.
- ☐ I might try a few things differently.
- ☐ Got me thinking, but that's about all.
- ☐ Total waste of time.

During this training, what percentage of the time were you saying to yourself…?

I knew that already! (i.e., it was too simple).	
That was new to me and I understood the idea!	
You lost me on that! (i.e., that was over my head)	
Must Total	**100**

How likely is it that you would recommend our company/product/service to a friend or colleague?

😀 **Extremely likely**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1** **Not at all likely** 😡

In general, how do you rate the content of this training? (Circle a number)

Better than I expected	**5**	**4**	**3**	**2**	**1**	**Not as good as I expected**
Good style & delivery	**5**	**4**	**3**	**2**	**1**	**Poor presentation style & delivery**
Well-organized	**5**	**4**	**3**	**2**	**1**	**Totally unorganized**
Too much information	**5**	**4**	**3**	**2**	**1**	**Too little information**

How did this workshop change… (Circle a number)

Your knowledge?	Greatly Improved	**5**	**4**	**3**	**2**	**1**	No change
Your interest in this topic?	Greatly Improved	**5**	**4**	**3**	**2**	**1**	No change
Your confidence in using these skills?	Greatly Improved	**5**	**4**	**3**	**2**	**1**	No change

As a result of this meeting, what do you plan to do differently in your operation? How has this workshop helped you?

If you could add one topic to the Georgia Grazing School agenda, what would it be and why?

Was there any topic that should have been left off the agenda?

(Do the back side, too!)

Please rate the effectiveness of each of the instruction modules and activities.

Module/Activity	*Excellent*	*Very Good*	*Good*	*Fair*	*Poor*
Manipulating forage growth and grazing behavior: the essence of rational grazing	5	4	3	2	1
Southern Forages: Yield, distribution, and quality	5	4	3	2	1
Soil fertility and nutrient cycling in grazing systems	5	4	3	2	1
Managing, utilizing, and maintaining legumes	5	4	3	2	1
Segregating herds based on animal class and nutritional need	5	4	3	2	1
Grazing systems, methods, and tricks	5	4	3	2	1
Optimizing the size, number, and layout of your paddocks	5	4	3	2	1
Managing forage surplus and deficits	5	4	3	2	1
Sketching Out the Ideal: Planning the Grazing System	5	4	3	2	1
Extending the grazing season and critically evaluating novel grazing systems	5	4	3	2	1
Cost-share programs that aid the transition	5	4	3	2	1
Good grazing = inc. soil moisture, inc. soil health, and lower erosion	5	4	3	2	1
Choosing the right fence, fence charger, and wire or tape for your grazing system	5	4	3	2	1
Selecting the right watering system and sizing the water supply for your grazing system	5	4	3	2	1
Using winter and summer annuals to ease seasonal transitions	5	4	3	2	1
Economics of Better Grazing Management	5	4	3	2	1
Sprayer calibration exercise and lightbar demo	5	4	3	2	1
New weed management tools for grazed pastures.	5	4	3	2	1
Demonstrations and farm exercises	5	4	3	2	1
Deep Grass Graziers	5	4	3	2	1

Other Comments:

Thank you for joining us for the 2016 Georgia Grazing School!