Hay, Baleage, and Forage Quality School
Aaron Gabriel, Cornell Cooperative Extension
March 2014

1. Improving a hay field
   A. Weed Management
   B. Frost-seeding
   C. No-till inter-seeding

2. Starting a new hay field
   1. Crop Rotations
   2. Fertility
   3. Forage Species Selection
   4. Tillage
   5. Seeding Rates
   6. Nurse Crops
   7. Harvest in the seeding year

*Images from several sources*
What Type of Plant?

Broadleaf

Grass

Sedge
Summer | Winter
---|---
Annual | Annual
Perennial | Biennial
• Mowing can be effective for many weeds if you mow at the correct time, height, and frequency.
• A sickle bar or haybine can be as effective as a rotary mower.
Mowing Strategies depend on the weed

Milkweed

Queen Anne’s Lace

Chickweed

Ragweed

http://agron-www.agron.iastate.edu/~weeds/

http://www.ediblewildfood.com/
Smooth Bedstraw - Know your enemy

• Perennial with a large rootsystem
• Seed viable for only one year
• Yr 1 prevent seed formation; Yr 2 use Crossbow
• or tillage & rotate to a winter & summer annual
Keep Poisonous plants out of hay

*Snakeroot   *Hemp Dogbane
*Milkweed   *Jimsonweed
Types of Herbicides

*READ THE LABEL (3 times)*

- Pre-emergent (relative to the weed)
- Post-emergent (relative to the weed)
- Residual (active in the soil for weeks/months/year)
- Non-residual (not soil active)

- Apply before crop emergence, while dormant, or to actively growing crop?
Herbicide Modes of Action

Growth regulators
Benzoic acids (Banvel, Clarity, Distinct, Status)
Phenoxy acetic acids (2,4-D, 2,4-DB)

Amino acid synthesis inhibitors
Amino acid derivatives
Glyphosate (Roundup and others)
Lipid synthesis inhibitors

Seedling growth inhibitors

Photosynthesis inhibitors

Cell membrane disruptors

Pigment inhibitors
<table>
<thead>
<tr>
<th>Site of Action</th>
<th>Family</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Microtubule assembly inhibition (10)</td>
<td>Dinitroaniline</td>
<td>Balan Pendimax Prowl</td>
</tr>
<tr>
<td>4 Synthetic auxin (24)</td>
<td>GROUP 2,4-D</td>
<td>Butyrac</td>
</tr>
<tr>
<td></td>
<td>Benzoic acid</td>
<td>Banvel Clarity</td>
</tr>
<tr>
<td></td>
<td>Carboxylic acid</td>
<td>Stinger</td>
</tr>
</tbody>
</table>
Resistance to Glyphosate is Possible... But is Known to be a Rare (8 in 2006); Now 28 resistant weeds (2014)

- The historical rate of development for glyphosate resistance is much slower than most all other herbicide families.
Observe to find unusual plants – the outliers.
Commonly Used Herbicides in Hay

**2,4-D / Banvel / Crossbow**
Growth regulators that kill all broadleaf weeds (and young grasses). Apply near bud stage when plants are actively growing in late-spring through summer. *Only Crossbow is effective on smooth bedstraw.*

**Glyphosate (RoundUp)**
Must be taken in by leaves and transported to roots. Apply to actively growing plants with plenty of foliage (grasses 8” tall). Works best in the fall as perennials store energy in roots. Will not kill annuals that are nearing the bud stage.
Good Management is needed to fill the holes left by dead weeds

- pH and fertility
- Cutting management
- Inter-seeding if needed
Frost Seeding

• From December through mid-March if no snow cover
• Need spots of bare soil, freeze-thaw cycles, rain
• Only vigorous seedlings w/dense small seeds:
  • Red Clover, Ladino Clover, Ryegrasses, Orchard grass (grasses are less reliable)
• Bare ground
• Graze or clip close in the fall
Seed/soil contact is important for tillage and non-tillage systems. establishment.

Broadcast

Aerway before seeding
Inter-seeding with a no-till drill to improve a thin field
• No-till seeding into an existing stand
• Use a species with a vigorous seedling
• Reduce the plant competition
• Rented drills may be in better condition early in the year, than in August
No-till Drill

- Multiple seed boxes
- Double disk openers
- Press wheels to close the seed furrow
- Heavy machine
Soil must be crumbly with good tilth for successful no-till seeding.
Starting a new hay field

1. Crop Rotations
2. Fertility
3. Forage Species Selection
4. Tillage
5. Seeding Rates
6. Nurse Crops
7. Harvest in the seeding year
Crop Rotation Calendar

<table>
<thead>
<tr>
<th>Dec / Jan / Feb</th>
<th>Mar / Apr / May</th>
<th>Jun / Jul / Aug</th>
<th>Sep / Oct / Nov</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial Forages</td>
<td>Perennials</td>
<td></td>
<td>Summer Annuals</td>
</tr>
<tr>
<td>Summer Annuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Annuals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter Annuals</td>
<td>Winter Annuals</td>
<td></td>
<td>Winter Annuals</td>
</tr>
</tbody>
</table>

Crops Grown Out of Their Natural Season

<table>
<thead>
<tr>
<th>Oats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Ryegrass</td>
</tr>
<tr>
<td>Ann. Ryegrass</td>
</tr>
</tbody>
</table>

Perennials: alfalfa, red & ladino clover, timothy, brome, orchard, fescue, P. rye, reed canary, chicory

Summer Annuals: BMR sorg/sudan, sudangrass, teff, cowpeas, soybean, crimson c.,

Spring Annuals: oats, spring grains, field pea, brassicas (radish/rape/swede), annual ryegrass

Winter Annuals: winter rye & winter grains, hairy vetch,
Alfalfa autotoxicity prohibits planting alfalfa within one year of a previous alfalfa crop.
Herbicide residues from previous crops can cause herbicide injury in new plantings.

0 days to 2 year “rotation intervals”
FERTILITY - Plan Ahead
Lime requires 1 year to neutralize soil.
Soil Test a year before seeding

Spend money on lime before buying fertilizer.

Soil test:
- Very low
- Low
- Medium/optimum
- High
- Very high

Fertilizer response likely. Response to fertilizer not likely.
Alfalfa – 0 lbs nitrogen at planting
Pure Grasses – 30 – 50 lbs nitrogen at planting
Boron Deficiency
Sulfur Deficiency
Access to manure is key to organic field crop production.

- 3- 5000 gal (10 ton) per acre topdress
- Spread within 2 days of harvest, on firm ground only
- Traffic will crack alfalfa crowns
- Nitrogen in manure stimulates weed seed germination
FORAGE SPECIES SELECTION: choose a forage adapted to the soil and climatic conditions.
Drainage is the major factor in selecting forage species.
## Legume Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Alfalfa</th>
<th>Red Clover</th>
<th>Ladino or White Clover</th>
<th>Birdsfoot Trefoil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drainage</strong></td>
<td>Moderate to well drained</td>
<td>Moderate to imperfect</td>
<td>Mod. to poorly drained; avoid droughty soils</td>
<td>Imperfect to poorly drain.</td>
</tr>
<tr>
<td><strong>Drought Tolerance</strong></td>
<td>Excellent</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Flood Tolerance</strong></td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Winterhardiness</strong></td>
<td>Good, variable</td>
<td>Fair</td>
<td>Fair; variable</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Soil pH Range</strong></td>
<td>6.2–7.5</td>
<td>6.0–6.7</td>
<td>5.5–6.5</td>
<td>5.0–6.5</td>
</tr>
<tr>
<td><strong>Seedling Vigor</strong></td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Cuttings/Year</strong></td>
<td>2 to 4</td>
<td>1 to 2*</td>
<td>1, usually grazed</td>
<td>1 to 2, usually grazed</td>
</tr>
</tbody>
</table>

*Modified from Timothy Griffin, U of Maine, Bulletin 2261*
Where Does RR Alfalfa Fit?

• In fields with perennial weed problems
• Where glyphosate is not being used for other crops
• Apply glyphosate at the 3 – 5 leaf stage alfalfa to remove 5 – 10% of glyphosate-susceptible individuals
• Grass can be inter-seeded after weed-free alfalfa is established
# Grass Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Kentucky</th>
<th>Timothy</th>
<th>Orchard</th>
<th>Smooth Brome</th>
<th>Reed Canary</th>
<th>Tall Fescue</th>
<th>Perennial Ryegrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Type</td>
<td>Sod</td>
<td>Bunch</td>
<td>Bunch</td>
<td>Sod</td>
<td>Sod</td>
<td>Bunch</td>
<td>Bunch</td>
</tr>
<tr>
<td>Heading date</td>
<td>E. May</td>
<td>E. June</td>
<td>Mid May</td>
<td>L. May</td>
<td>L. May</td>
<td>L. May</td>
<td>M/L May</td>
</tr>
<tr>
<td>Drainage</td>
<td>Poor to well</td>
<td>Mod. to imperfect; not dry</td>
<td>Mod. to well; gd srfc</td>
<td>Well drained</td>
<td>Poor to well drained</td>
<td>Mod. Poor to well dr.</td>
<td>Mod. Well to well dr.</td>
</tr>
<tr>
<td>Flood Tol.</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Exc.</td>
<td>V. gd</td>
<td>Poor</td>
</tr>
<tr>
<td>Drought Tol.</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
<td>Exc.</td>
<td>Exc.</td>
<td>Exc.</td>
<td>Poor</td>
</tr>
<tr>
<td>W. hardiness</td>
<td>Good</td>
<td>OK w/ ice</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Seed. Vigor</td>
<td>Mod.</td>
<td>Mod.</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>V. Good</td>
</tr>
<tr>
<td>N. Response</td>
<td>Fair</td>
<td>Fair</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Cuts/Year</td>
<td>1</td>
<td>1 to 2</td>
<td>2 to 3</td>
<td>2</td>
<td>2 to 4</td>
<td>2 to 4</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Sum.Growth</td>
<td>Fair;</td>
<td>Fair</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
<td>Good</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Modified from Timothy Griffin, U of Maine, Bulletin 2261
Selecting a Forage Variety

Test results from many years and locations are more predictive

Remember the Big Picture...

Look for the best “package” of traits when selecting an alfalfa variety:

“agronomics, disease resistance, fall dormancy rating, yield, etc.”
Integrated Pest Management

Proper species and variety selection are the first line of defense in IPM
Fig. 13. Key periods for monitoring alfalfa pest problems in New York.
Varietal Resistance is a major IPM strategy in field crops

PLH Resistant Alfalfa Cultivars
Alfalfa Disease Ratings

Susceptible: 0-5% resistant plants
Low Resistance: 6-14% resistant plants
Moderate Resistance: 15-30% resistant plants
Resistant: 31-50% resistant plants
High Resistance: >50% resistant plants
Alfalfa Fall Dormancy Ratings

very dormant [index 1]
dormant [2]
moderately dormant [3]
Semi-dormant [4,5,6]
moderately non-dormant [7]
Non-dormant [8]
very non-dormant [9]
Tillage

WANTED: Friable, porous, well-structured soil

What is your purpose for tillage???

- Relieve compaction?
- Weed control?
- Smooth out ruts?
- Incorporate lime or other amendments?
Which soil may have had too much tillage?
No-till seeding into a killed sod

http://extension.missouri.edu/explore/images/m00183art08.jpg
Primary Tillage
Completely invert to kill old sod

Secondary Tillage
Primary or Secondary Tillage?
Primary or secondary tillage?
A fine seedbed is needed for small seeded crops and a smooth field is more efficient and more fun to work.
Primary or secondary tillage?

http://www.vinetechequipment.com/hay_rennovator_aerator.jpg
A regular grain drill with a hay seed box can be used in a prepared seedbed. A firm seedbed allows moisture to wick upward to the seed. You should barely leave a footprint in it. This seedbed is too loose.
Brillion-type seeders drop seed between two sets of rolls that press the seed into the soil.

Seeding depths
• Birdsfoot Trefoil & Teff: 1/8”
• Sudangrass: 1/2”
• Other grasses & legumes: 1/4”
• Small Grains: 1 to 1 1/2”
### Seeding Rates

**Table 4.2.1. Forage for hay or silage.**

<table>
<thead>
<tr>
<th>Soil Conditions and Desired Management</th>
<th>Crop¹</th>
<th>Seeding Rate (lb./A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-drained soils, early first cut, 3 to 4 cuttings</td>
<td>Alfalfa</td>
<td>12–15</td>
</tr>
<tr>
<td></td>
<td>Alfalfa and timothy or bromegrass or orchardgrass or reed canarygrass</td>
<td>8–12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4–6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5–8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4–6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6–8</td>
</tr>
<tr>
<td>Moderately to well-drained soils, 2 to 3 cuttings</td>
<td>Alfalfa</td>
<td>12–15</td>
</tr>
<tr>
<td></td>
<td>Alfalfa and timothy or bromegrass</td>
<td>8–12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4–6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5–8</td>
</tr>
<tr>
<td>Variable drainage with spots in field too wet for alfalfa, 2 to 3 cuttings</td>
<td>Alfalfa and birdsfoot trefoil and timothy or reed canarygrass</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6–8</td>
</tr>
<tr>
<td>Poorly to well-drained soils, short-term hay, 1 to 2 years</td>
<td>Red clover and timothy</td>
<td>6–8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Moderately to well-drained soils, grasses, 3 to 4 cuttings</td>
<td>Timothy or orchardgrass or reed canarygrass</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8–10</td>
</tr>
</tbody>
</table>

¹Crop: Alfalfa, Alfalfa and timothy or bromegrass or orchardgrass or reed canarygrass, birdsfoot trefoil and timothy or reed canarygrass.
Coated Seed:
• Clay & glue possibly with rhizobia, fungicides, micro-nutrients, biological inoculants
• Makes tiny seeds easier to manage
• May flow faster than raw seed
• May be 1/3 heavier than raw seed
• Check bag for rhizobia expiration
• Calibrate the seeder
• Research results are mixed on its benefits

Fluffy Seed
• Mix with oats or phosphorus fertilizer to prevent bridging
Nurse-Crop Seedings

• + SAVE SOIL
• + DISPLACE WEEDS
• + PROVIDE STRAW
• -- COMPETES WITH LEGUME
• -- LESS HARVESESED LEGUME IN SEEDING YEAR

• +- OATLAGE IS A COMPROMISE
Erosion always takes the best soil. A nurse crop can hold the soil.
Oats seeded at a reduced rate is the typical nurse crop used to reduce weeds, control erosion, & provide more forage, but it may also compete with the hay crop and cause moisture stress.
Allow alfalfa to flower to at least 10% before harvesting the very first time. Grasses should be at 12 inches tall before the very first harvest. (Mow grasses at 4 inches.)
Ahh! The smell of fresh-cut hay!
Mission Statement

• Get one and write it down
• It’s all about YOU – why you are in business based on your values
• Also describes the products/services of the business and their purpose.
Problem Diagnosis

- Determine the root cause of a problem
  - Technical reasons
  - Management reasons

The root cause of a problem can always be traced to what a *person* did or did not do.
Tactical Planning

- Precise, individually itemized action plan.

- Who, What, Where, When, and How activity will take place to reach a goal
A Manager’s Guide - when the Going Gets Rough...

...or when the Stakes are High

The Functions of Management

Planning
- Problem Identification
- Create Alternatives
- Decision Making
- Mission
- Objectives
- Goals
- Tactics
- Recruiting
- Hiring
- Training
- Evaluation
- Compensation
- Leadership

Staffing
- Authority
- Relationships
- Staff Functions
- Systems Design
- Structure
- Standards
- Comparison with Goals

Organizing
- Evaluation
- Corrective Action
- Reporting
- Reward
- Formative Action
- Coaching
- Power
- Communication
- Delegation
- Motivation

Controlling

Directing

Staffing

Planning

Organizing

Controlling