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

2. Starting a new hay field
   1. Crop Rotations
   2. Forage Species Selection
   3. Tillage
   4. Seeding Rates
   5. Nurse Crops
   6. Harvest in the seeding year
What Type of Plant?

Broadleaf

Grass

Sedge
Summer  Winter
Annual  Annual
Perennial  Bienniel
Chickweed – winter annual
Burdock, Queen Anne’s Lace – biennial
Milkweed, Horsenettle – rhizomatous perennial

Ragweed - annual

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

http://www.ediblewildfood.com/

Univ. of Delaware
• Milkweed
• Snakeroot
• Hemp Dogbane
• Jimsonweed
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.
Types of Herbicides

• Pre-emergent (relative to the weed)
• Post-emergent (relative to the weed)

• Residual (active in the soil for weeks/months/year) or
• 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
## SITE OF ACTION CLASSIFICATION

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

The historical rate of development for glyphosate resistance is much slower than most all other herbicide families.

Source: Ian Heap
www.weedscience.com
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.
Frost Seeding
Bare ground is needed & reduced plant competition for frost seeding.
Tillage improves seed establishment.

Broadcast

Aerway before seeding
No-till seeding into an existing stand – use a species with a vigorous seedling and reduce the plant competition.
Starting a new hay field

1. Crop Rotations
2. Forage Species Selection
3. Tillage
4. Seeding Rates
5. Nurse Crops
6. Harvest in the seeding year
<table>
<thead>
<tr>
<th>Crop Rotation Calendar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dec / Jan / Feb</strong></td>
</tr>
<tr>
<td>Perennial Forages</td>
</tr>
<tr>
<td>Summer Annuals</td>
</tr>
<tr>
<td>Spring Annuals</td>
</tr>
<tr>
<td>Winter Annuals</td>
</tr>
<tr>
<td>Crops Grown Out of Their Natural Season</td>
</tr>
<tr>
<td>Oats</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
Herbicide residues from previous crops can cause herbicide injury in new plantings.
Plan Ahead - Lime requires 1 year to neutralize soil.

pH Scale for Soils

ACIDIC
- Battery Acid
- Lemon Juice
- Cola
- Orange Juice
- Coffee
- Corn
- Distilled Water

5

NEUTRAL
- Sea Water
- Antacid

10

BASIC
- Ammonia
- Beach
- Lye

The pH Tolerance Levels for Plants

ACIDIC
- Bunchberry
- Crowberry
- Rosy Twistedstalk
- Twinflower

NEUTRAL
- Tea
- Aser
- Birch
- Bleeding Heart
- Blueberry
- Brackenfern
- Chinquapin
- Fr.
- Hemlock
- Indian Pipe
- Oregon Iris
- Pearly Everlasting
- Pine
- Rattlesnake
- Plantain
- Rhododendron
- Scotch Broom
- Spreading Phlox
- Spruce
- Wild Ginger

The pH Tolerance Levels for Plants

ACIDIC
- Blackberry

NEUTRAL
- Alder
- Apple Trees
- Chicory
- Larch
- Timothy Grass

The pH Tolerance Levels for Plants

ACIDIC
- Backed Hazelnut
- Black Oak
- Clover
- Colorado Spruce
- Douglas Fir
- Red Cedar
- Spreading Dogbane
- Vetch

NEUTRAL
- Ash
- Baneberry
- Back Hawthorne
- Buckthorn
- Buttercup
- Camas
- Catalpa
- Chokeberry
- Cinquefoil
- Columbine
- Currant
- Dandelion
- English Ivy
- Foxglove
- Honeysuckle
- Larkspur
- Loosestrife
- Maidenhall Fern
- Maple
- Ninebark
- Orchard Grass
- Oregon Grape
- Oxalis
- Penstemon
- Rose
- St. John’s Wort
- Saxifrage
- Shooting Star
- Snowberry
Soil tests classifications indicate whether or not adding a nutrient is likely to result in a yield increase.

Soil Test Interpretation

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
Select a forage adapted to the soil and climatic conditions.
<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>Drainage</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>Drought Tolerance</td>
<td>Excellent</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Flood Tolerance</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>Winterhardiness</td>
<td>Good, variable</td>
<td>Fair</td>
<td>Fair; variable</td>
<td>Good</td>
</tr>
<tr>
<td>Soil pH Range</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>Seedling Vigor</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Cuttings/Year</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
<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>Fair</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
Tillage

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
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_renovator_aerator.jpg
<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</td>
<td>8–12</td>
</tr>
<tr>
<td></td>
<td>bromegrass or</td>
<td>4–6</td>
</tr>
<tr>
<td></td>
<td>orchardgrass or</td>
<td>5–8</td>
</tr>
<tr>
<td></td>
<td>reed canarygrass</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</td>
<td>8–12</td>
</tr>
<tr>
<td></td>
<td>bromegrass</td>
<td>4–6</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</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>reed canarygrass</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>8–10</td>
</tr>
</tbody>
</table>

¹ Crop: Additional crops may be included depending on local availability and specific crop requirements.
COMPANION SEEDINGS

+ SAVE SOIL
+ DISPLACE WEEDS
+ PROVIDE STRAW

-- COMPETES WITH LEGUME
-- LESS HARVESED 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.