

“Use of annual forages in pasture rotations and as cover crops to benefit small ruminant farming systems”

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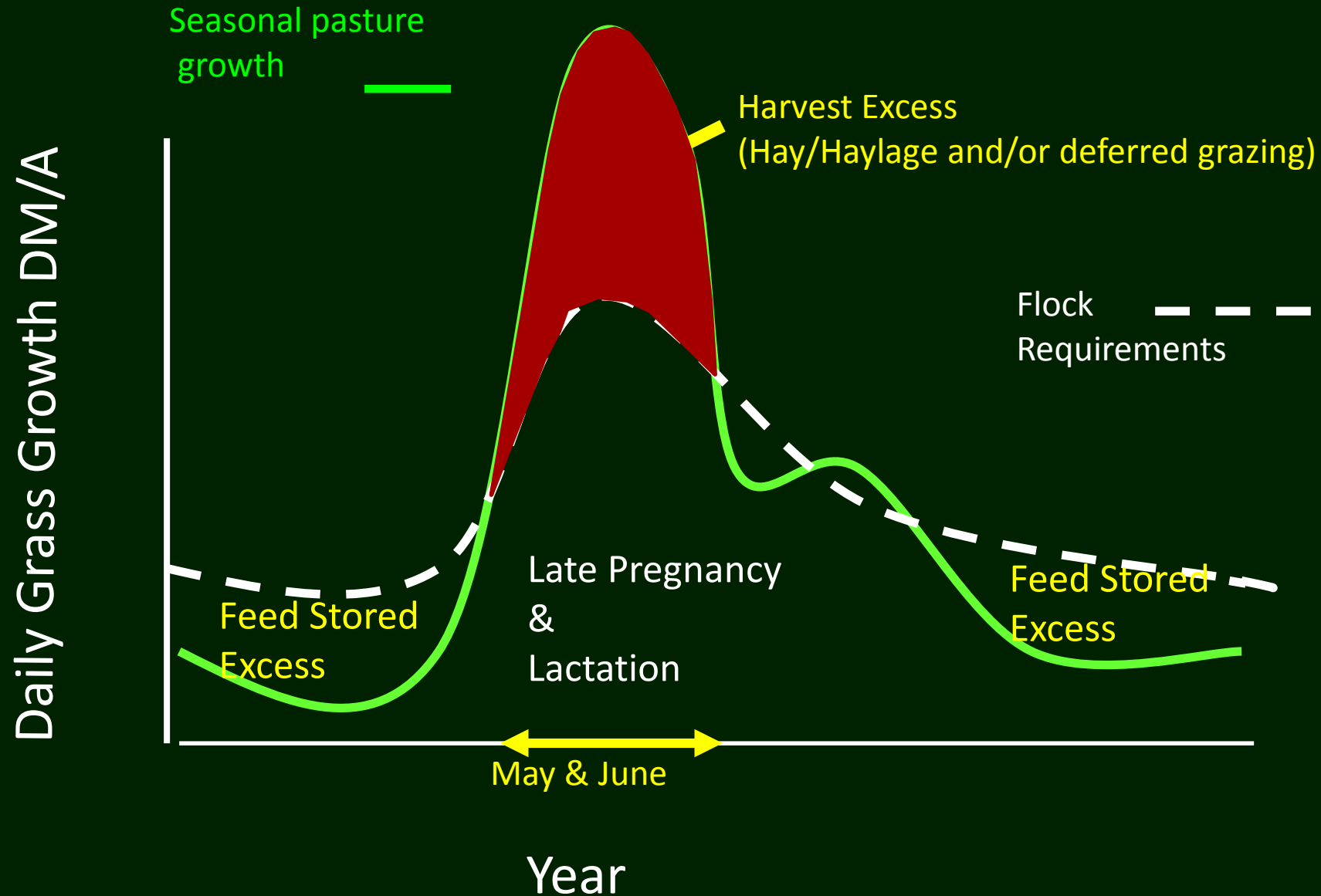
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Challenge to forage production systems on small ruminant farms:

Can we alter and optimize forage systems to:

- Improve whole-farm forage utilization?
- Meet the nutritional needs of the highly productive animals?
- Lower cost of production?
- Improve soil and land carrying capacity?
- Improve animal health/welfare?

Efficient pasture-based systems strive to match animal needs and forage availability



Supply side strategies to improve whole farm forage utilization:

1. Improve grazing management of perennial pastures
2. Improve harvest management of perennial excess
3. *Diversify the forage base: Include annual forages in perennial rotation and/or as cover crops to improve forage availability (quality and quantity) for grazing or machine harvest, improve soil and land carrying capacity.*

How can forage base diversification with annual forages improve whole-farm forage utilization?

- **Fill in deficits** in perennial pasture production
 - ✓ extend the grazing season and **reduce stored forage use**
- **Improve forage quality at times of need**
 - ✓ **Improve energy** content of forage (soluble CHO and fiber digestibility)
 - Late pregnancy and lactation of prolific ewes
 - Growing lambs
- **Provide “safe” forages, low in parasite infectivity**
- **Improve productive capacity of the land**
 - ✓ Replacement of low productivity pastures
 - Addition of soil amendments (manure, lime, etc.)
 - Replace with more productive and/or palatable species
 - ✓ Rests perennials to improve productivity and resilience
 - ✓ Annuals can out-yield perennials if strategically planted
 - ✓ Allows an increase in total forage output including stored forage

Case study of a complimentary forage rotation system :

- **Perennial pasture renovation targets:**
 - ✓ Pastures of poor yield and/or species composition
 - ✓ Pasture birth paddocks
- **Year 1-Brassica, warm season (C4) or brassica/C4 mixture planted into herbicide killed sod after approx. 50-60% of seasonal biomass production has been harvested by grazing or machine harvest**
- **Year 2-Red clover ,Italian ryegrass, chicory (biennial/short term perennial mixture) planted into brassica/C4 stubble from year 1.**
- **Year 3-Continued grazing of biennial/short term perennial mixture, then reestablishment of *perennial pasture in late summer/early fall***
- ***Years 4-8?-Perennial pasture***



Year 1

Year 2

Year 3

Year 1: “double-cropping of perennial pasture with annual forage”

- Goal: Provide high quality, parasite free forage that will fill in the summer slump period **and** exceed yield of perennial pasture
- Annual forage crop planted in late June/early July after >60% perennial pasture annual yield.
- Soil amendments added (compost, manure, etc.)
 - Annual crops that germinate under limited soil moisture:
 - ✓ Sudan hybrids (C4)
 - ✓ Forage brassicas
 - ✓ Brassica and warm season grass (C4) combinations
 - No-till seeding will limit moisture loss





'Graza'

'Winfred'

'Calvin'

'Goliath'

60 days after planting

BMR sudan grass and 'Hunter' (forage turnip x chinese cabbage) strips- day 25 after planting



‘Goliath’ (rape x kale) at 50 days post emergence, Sept 22, 2015



Post weaning ewe lambs grazing a monoculture of 'Hunter' forage (turnip x chinese cabbage)



Year 2-3: High quality, short term perennial pasture

- **Goal: provide forage with outstanding quality and yield to maximize performance per unit land**
- **Additional soil amendments (manure, compost, lime, etc.) added and planting performed in early Spring.**
- **Legume, forb, grass mixture (Red clover, chicory, rye grass).**
- **Grazed for 2 years**

Short term perennial pasture of red clover/Italian ryegrass mixture in year 2



Lamb growth performance was assessed in grazing trials on annual and short term perennial forage crops:

- 28 day grazing periods with 2-4 day grazing bouts
- Pre- and post- grazing crop mass measurements
- Crop yield and production costs calculated



Species	Date planted	Grazing period (days)	DM Yield (lb/acre)	Intake target	Gain per lamb (lb/d)	Gain per acre (lb/acre)	Cost of gain (\$/lb)
'Hunter' turnip and BMR sudan mix	June 22 Annual	112	8154	45%	0.68	708	0.41
'Hunter' turnip	June 22 Annual	112	9793	45%	0.68	729	0.37
'Hunter' turnip and BMR sudan strips	June 22 Annual	112	9123	45%	0.61	751	0.38
BMR sudan	June 22 Annual	112	7850	45%	0.45	454	0.68
Red clover and Italian ryegrass	April 22 Short term perennial	153	8887	45%	0.61	1275	0.20
Orchard grass, tall fescue and alfalfa	Perennial	194	10608	45%	0.28	955	0.23

Projection of lamb gain
potential in 2 forage systems
(pound of gain per acre)

	<u>Perennial</u>	<u>Annual/Short term Perennial</u>
Year 1	955	573+724=1297
Year 2	955	1275
Year 3	955	1275
Total	2865	3847

- Improvements in forage quality improved land productivity close to 30% with added opportunity to decrease cost of gain

Cover crop grazing for small ruminants: a huge opportunity to improve production efficiency

- Use of annual forages within a cropping system
- Gigantic potential after primary crops of small grains, vegetables and corn harvested for silage
- *Fencing and water are barriers but easily overcome*
- *Opportunity for synergy between crop and livestock programs*
 - ✓ Within a farming program
 - ✓ *Partnership with neighboring farms*
- Crop farmers use cover crops for nutrient scavenging, soil protection, pest and weed control.
- Cover crops provide quality feed that can be *stockpiled* and can fill a deficit in a forage program

Small ruminant cover crop grazing program

2010-2017:

- Brassica, radish (4-9 lbs/acre) and oat (30-50 lbs/acre) combinations evaluated
- Planted into wheat stubble (July 25-Aug 20)
- Addition of 50 pounds N/ acre in early September
- Sheep introduced between October 1 and 25
- Sheep removed Jan 10-March 15
- Crop and sheep farm agreement:
 - ✓ Sheep farm: seed and fertilizer, manages grazing
 - ✓ Crop farm: plants seed

Cover crop combinations:

- **Brassicas, radish and small grains:**

- ✓ Provide complementary (high soluble CHO plus digestible fiber)
- ✓ Combination lowers risks of crop failure
- ✓ Small grains help control mud issues during wet weather grazing

- **Brassica/radish choice:**

- ✓ **Bulb turnips**

- Bulbs stockpile well into february, tops are lost after extended cold $< 15^{\circ} \text{F}$

- ✓ **Rape and Kale hybrids**

- Tops hold quality longer than turnips, loose quality after extended cold at $< 0^{\circ} \text{F}$

- ✓ **Radishes**

- Only top part of bulb available but tops hold quality longer than turnip bulbs but less than rape
- Perhaps a good compromise between land and livestock benefits

Candidates for cover crops: Rape hybrids, Turnips, Radishes



**40 days post emergence, Sept. 28, 2012;
planted following break in 25 year drought**

Cover Crops: Oil seed radish and oats



**Early winter cover crop grazing:
Oats, purple top turnips, oil seed
radish and forage rape
December 10, 2014**



**Sheep in final grazing rotation before driven to home farm,
January 10, 2011**







**“Winfred” forage rape hybrid
January 20, 2013**

**‘Hunter’ Chinese cabbage x forage turnip
January 20, 2013**



115 lb lambs fed no grain, 7 mo. old



Cost per ton of forage utilized (\$)

	No seed	Turnips and Oats	Radishes and Oats	Turnips, Radishes and Oats
No fertilizer	0	32	29.7	32.5
46 lbs N	102	37.7	42.8	35.6

Nutritional value of cover crop mixes

	No seed	Turnips and Oats	Radishes and Oats	Turnips, Radishes and Oats
Crude Protein (%)	21	12	12	12
ADF ¹ (%)	23	24	25	24
NDF ² (%)	43	38	38	36
TDN ³ (%)	77	75	75	76
48 h dry matter digestibility	93	90	90	91

¹ ADF=acid detergent fiber

²NDF=neutral detergent fiber

³TDN=total digestible nutrients

Barriers for adoption of cover crop grazing:

- Fencing –need for security and portability
- Water-how can it be supplied during late fall and winter on crop land?

**Electric netting is a secure and portable fencing option
(35" plastic strut version shown)**

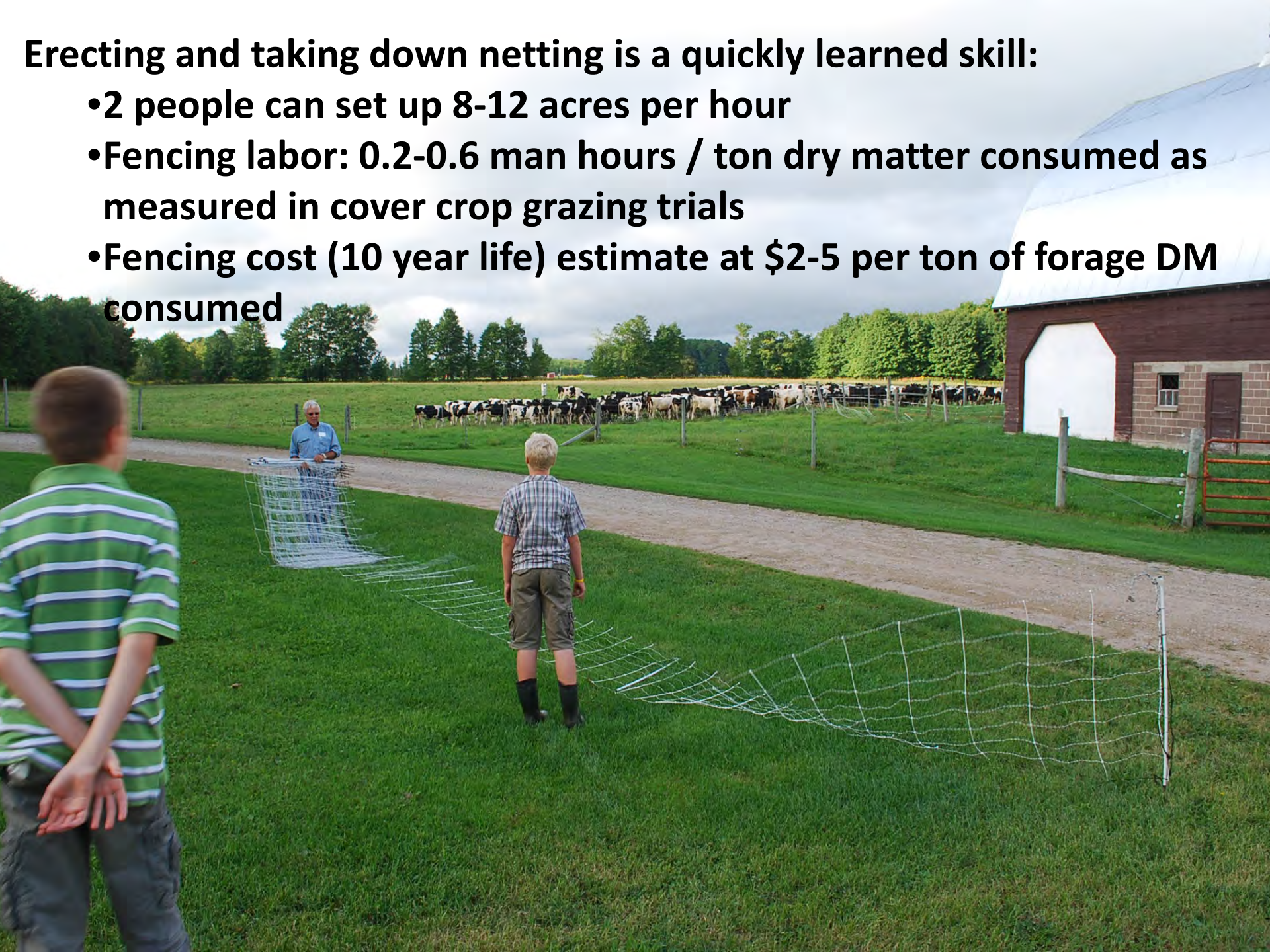


- Plastic strut versions can “cope” with ice or snow load
- Winter grazing areas need to be fenced before frost gets >1 inch deep
~late Dec. to early Jan. in southern MI



Erecting and taking down netting is a quickly learned skill:

- **2 people can set up 8-12 acres per hour**
- **Fencing labor: 0.2-0.6 man hours / ton dry matter consumed as measured in cover crop grazing trials**
- **Fencing cost (10 year life) estimate at \$2-5 per ton of forage DM consumed**



Factors to consider when assessing water needs of livestock during cover crop grazing

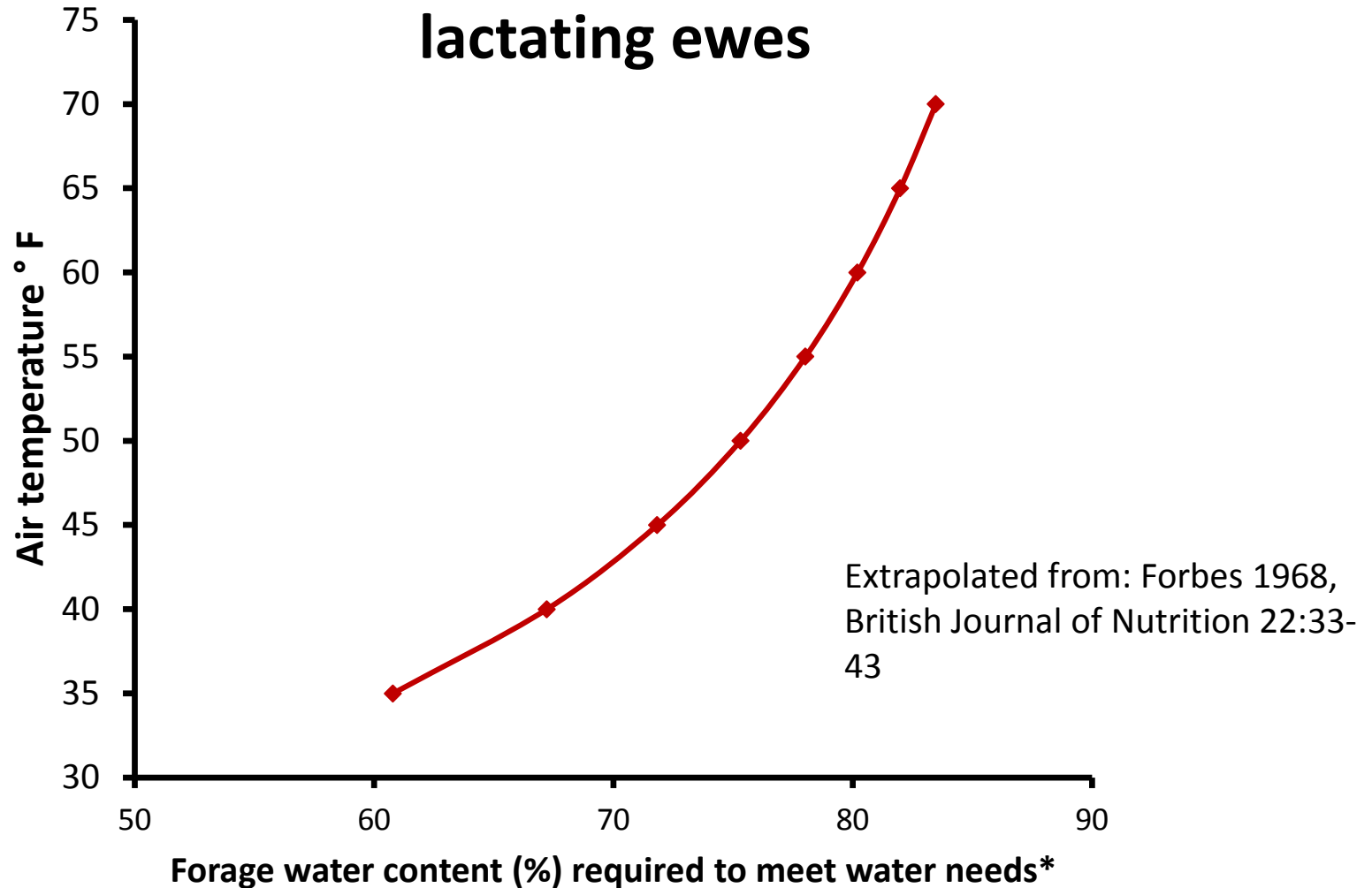
- Most cover crops are lush and with a water content (>80%) through mid fall which declines as the crop dies and is subject to freeze/thaw conditions
- Livestock water needs decrease by ~50% between 72° and 36° F
- Water needs are dependent on stage of production: (maintenance<growth<pregnancy<lactation)
- Snow is a major water source for winter grazing

Forage water content required to meet water needs according to species and production state during cool weather (<55° F).

<u>Species</u>	<u>Production State</u>	<u>Forage water %</u>
Sheep	non-lactating, first 2/3 pregnancy	66
	last 30 days of pregnancy -singles	80
	last 30 days of pregnancy-twins	87
Cattle	non-lactating, first 2/3 pregnancy	74
	late pregnancy	85

Adapted from “Nutrient requirements of domesticated ruminants” CSIRO 2007

Relationship between air temperature and forage water content required to meet water need of non-lactating ewes



* Needs of non-lactating ewes before the last 30 days of pregnancy

Forage water content needs to be meets the need of most sheep classes except prolific ewes during late pregnancy

- Consumption of soft snow can make up deficit
- May need to move ewes off winter grazing during late pregnancy





Forage water (oats plus radishes) in mid January = 76%



Brassica tubers are >90% water

Slide courtesy of J.S. Rook

Supplemental feeding may be necessary when icy/frozen snow conditions limit grazing access



Summary:

- The use of annual forages in pasture rotation systems can improve forage yield and quality providing a needed boost to modern sheep and goat programs with prolific animals.
- Cover crop grazing with small ruminants has many benefits:
 - ✓ Improved parasite management
 - ✓ Inexpensive yet quality forage
 - ✓ Resting of perennial pastures
 - ✓ Quality forage at times of need
- Portable electric netting fence allows for secure containment of sheep and goats without the need for permanent fence
- Forage water content of cover crops in winter is high enough to meet the water needs of non-lactating sheep and goats before late pregnancy.

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