TREE HAY

Scientific data for better farm decisions

By Ilia Rashev

Today’s presentation will include:

Nutritional comparison between alfalfa and "tree hay," based on analysis of available scientific research.

Changes in animal performance with the inclusion of tree hay or active compounds in the animal diets.

Tree systems integrated with current farm practices and the available technology.

If time permits, Q&A.

Why am I doing this research?

To determine if TREE HAY IS as good as or SUPERIOR to conventional hay.

Why am I giving this presentation?

Doubt often leads to failure when integrating new systems. Farmers may not be willing to invest proper resources or effort if they are uncertain about the efficacy of a new practice.

To eliminate doubt, there are two options: blindly trust in a system or person, or rely on scientific data and understanding.

My goal is to provide farmers with information that explains why tree hay is superior and how to produce and use it effectively.

Forage test Alfalfa

	A	B	C	D	E	F	G	H	I	J	K	L
1	Alfalfa, aerial part, fresh	https://www.feedipedia.org/node/275						Alfalfa, dehydrated	https://www.feedipedia.org/node/11744			
2												
3	Main analysis	Unit						Main analysis	Unit			
4	Dry matter	% as fed	19.9					Dry matter	% as fed	90.6		
5	Crude protein	% DM	20.6					Crude protein	% DM	18.3		
6	Crude fibre	% DM	26.7					Crude fibre	% DM	28.6		
7	NDF	% DM	39.3					NDF	% DM	45.9		
8	ADF	% DM	30.9					ADF	% DM	32.7		
9	Lignin	% DM	7.6					Lignin	% DM	8.5		
10	Ether extract	% DM	2.9					Ether extract	% DM	2.7		
11	Ash	% DM	11.5					Ash	% DM	11.7		
12	Gross energy	MJ/kg DM	18.1					Starch (polarimetry)	% DM	3.3		
13	Starch (polarimetry)	% DM	0.3					Total sugars	% DM	4.5		
14	Water-soluble carboh	% DM	5.6					Gross energy	MJ/kg DM	18		
15												
16	Minerals	Unit	Avg					Minerals	Unit			
17	Calcium	g/kg DM	19.4					Calcium	g/kg DM	22.1		
18	Phosphorus	g/kg DM	2.5					Phosphorus	g/kg DM	2.7		
19	Potassium	g/kg DM	22.4					Potassium	g/kg DM	25.6		
20	Sodium	g/kg DM	0.5					Sodium	g/kg DM	0.2		
21	Magnesium	g/kg DM	2.8					Magnesium	g/kg DM	2.1		
22	Manganese	mg/kg DM	76					Manganese	mg/kg DM	32		
23	Zinc	mg/kg DM	43					Zinc	mg/kg DM	30		
24	Copper	mg/kg DM	13					Copper	mg/kg DM	6		
25	Iron	mg/kg DM	387					Iron	mg/kg DM	544		
26												

Fresh leaves Alfalfa vs Morus alba comparison 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Alfalfa, aerial part, fresh		https://www.feedipedia.org/node/275						White mulberry (Morus alba), aerial part, fresh		https://www.feedipedia.org/node/12764				
2															
3	Main analysis	Unit	Avg	SD	Min	Max	Nb		Main analysis	Unit	Avg	SD	Min	Max	Nb
4	Dry matter	% as fed	19.9	3.1	14.1	33.3	1277		Dry matter	% as fed	30.2	5.6	24.2	46.3	25
5	Crude protein	% DM	20.6	3.4	12	31.8	1832		Crude protein	% DM	19.1	4.2	11.5	26.4	36
6	Crude fibre	% DM	26.7	4.1	15.6	38.2	1187		Crude fibre	% DM	13.5	2	13.3	20.2	9
7	NDF	% DM	39.3	6.3	25	59.6	1305		Neutral detergent fib	% DM	30.9	5.4	19.4	43.3	26
8	ADF	% DM	30.9	5	18.4	44.8	1451		Acid detergent fibre	% DM	22.3	5.2	14.8	32.7	24
9	Lignin	% DM	7.6	1.8	3.5	12.6	1224		Lignin	% DM	5.4	2	3.8	10.8	11
10	Ether extract	% DM	2.9	0.7	1.4	4.9	1058		Ether extract	% DM	5.6	1.8	3	7.4	5
11	Ash	% DM	11.5	1.9	7.5	19.7	1484		Ash	% DM	12.3	4	4.4	22.2	29
12	Gross energy	MJ/kg DM	18.1	1	16.7	19.4	7		Gross energy	MJ/kg DM	18.2				
13	Starch (polarimetry)	% DM	0.3				1		Insoluble ash	% DM	3.5		1.9	5.2	2
14	Water-soluble carbol	% DM	5.6	1.5	3.4	8.1	10								
15															
16	Minerals	Unit	Avg	SD	Min	Max	Nb		Minerals	Unit	Avg	SD	Min	Max	Nb
17	Calcium	g/kg DM	19.4	3.3	10.9	27.6	1095		Calcium	g/kg DM	22.3	7.6	13.8	36	6
18	Phosphorus	g/kg DM	2.5	0.6	1	5.2	1195		Phosphorus	g/kg DM	3.2	1.7	1.2	5.7	7
19	Potassium	g/kg DM	22.4	6.3	13.2	34.6	100		Potassium	g/kg DM	17.5				1
20	Sodium	g/kg DM	0.5	0.2	0.1	1	71		Sodium	g/kg DM	2				1
21	Magnesium	g/kg DM	2.8	0.8	1.7	4.8	875		Magnesium	g/kg DM	4.9		3.2	7.2	4
22	Manganese	mg/kg DM	76	63	24	246	100		Manganese	mg/kg DM	31		30	32	2
23	Zinc	mg/kg DM	43	31	17	176	57		Zinc	mg/kg DM	55		22	109	3
24	Copper	mg/kg DM	13	3	8	20	59		Copper	mg/kg DM	10		4	20	3
25	Iron	mg/kg DM	387	251	122	1121	106		Iron	mg/kg DM	322		87	782	3
26									Selenium	mg/kg DM	0.1		0.05	0.2	2
27									Sulfur	g/kg DM	2.6		2.1	3	2

Fresh leaves Alfalfa vs Morus alba comparison 2

	Amino acids	Unit	Avg	SD	Min	Max	Nb		Amino acids	Unit	Avg	SD	Min	Max	Nb
30	Alanine	% protein	6.4	0.2	6.2	6.6	5		Alanine	g/16g N	5.1		3.7	6.5	2
31	Arginine	% protein	4.5	0.3	4.1	4.9	7		Arginine	g/16g N	7.4		5.8	8.9	2
32	Aspartic acid	% protein	11.3	0.5	10.6	12	5		Aspartic acid	g/16g N	8.8		6.4	11.2	2
33	Glutamic acid	% protein	9.6	0.4	9.2	10.2	5		Glutamic acid	g/16g N	8.9		8.7	9	2
34	Glycine	% protein	4.6	0.2	4.5	4.8	6		Glycine	g/16g N	4.8		4.1	5.6	2
35	Histidine	% protein	2	0.2	1.8	2.2	7		Histidine	g/16g N	2.2		2.1	2.3	2
36	Isoleucine	% protein	4.1	0.2	3.9	4.3	7		Isoleucine	g/16g N	3.6		2.6	4.6	2
37	Leucine	% protein	6.5	2.3	1.3	8	7		Leucine	g/16g N	7.6		6.4	8.8	2
38	Lysine	% protein	5.5	1	4.3	6.8	7		Lysine	g/16g N	4.2		4.2	4.3	2
39	Methionine	% protein	1.6	0.5	0.9	2.5	7		Methionine	g/16g N	1.9		1.8	2	2
40	Phenylalanine	% protein	4.5	0.3	4.1	4.9	7		Phenylalanine	g/16g N	3.8		3.5	4	2
41	Proline	% protein	4.8	0.3	4.5	5.3	5		Proline	g/16g N	4.4		4.3	4.4	
42	Serine	% protein	3.6	1.1	1.7	4.4	5		Serine	g/16g N	4.6		2.8	6.4	2
43	Threonine	% protein	4.2	0.2	4	4.6	7		Threonine	g/16g N	3.9		2.8	5	2
44	Tyrosine	% protein	3.4	0.2	3.2	3.7	7		Tyrosine	g/16g N	3.8		3.6	4	2
45	Valine	% protein	6.4	0.9	5	7.1	7		Valine	g/16g N	5.6		5.4	5.7	2
46	Cystine	% protein	1.3	0.1	1.1	1.5	6								2
47	Tryptophan	% protein	1.5				1		Secondary metabolite	Unit	Avg	SD	Min	Max	Nb
48	Alfalfa is a nontannin-containing legume						https://academic.oup		Tanins, condensed (ec	g/kg DM	7	6	0	20	7
49									Bioflavonoids						

Fresh leaves Alfalfa vs Morus alba comparison 3

	Ruminant nutritive va	Unit	Avg	SD	Min	Max	Nb
52	OM digestibility, Rumi	%	68.5	5.5	59	80.7	112
53	Energy digestibility, ru	%	65.5	8.8	49	68	6
54	DE ruminants	MJ/kg DM	11.9				
55	ME ruminants	MJ/kg DM	9.4				
56	Nitrogen digestibility,	%	78.5	3.6	69.4	85.9	69
57	a (N)	%	44.1	5.8	35.3	50.8	6
58	b (N)	%	46.6	6.1	37.8	54	6
59	c (N)	h-1	0.169	0.087	0.08	0.287	5
60	Nitrogen degradabilit	%	82				
61	Nitrogen degradabilit	%	78	5	70	88	18
62							
63							
64							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74	Pig nutritive values	Unit	Avg	SD	Min	Max	Nb
75	DE growing pig	MJ/kg DM	8.7				
76	NE growing pig	MJ/kg DM	4.4				
77	Energy digestibility, gr	%	48.1				
78							
79							

	Ruminants nutritive v	Unit	Avg	SD	Min	Max	Nb
52	OM digestibility, rumi	%	80.6				
53	Energy digestibility, ru	%	77.1				
54	DE ruminants	MJ/kg DM	14				
55	ME ruminants	MJ/kg DM	11.3				
56	Nitrogen digestibility,	%	79				
57	a (N)	%	36				1
58	b (N)	%	61				1
59	c (N)	h-1	0.1				1
60	Nitrogen degradabilit	%	74		71	74	2
61	Nitrogen degradabilit	%	80				1
62							
63	In vitro digestibility ar	Unit	Avg	SD	Min	Max	Nb
64	In vitro DM digestibili	%	68	15	52	80	5
65	In vitro OM digestibili	%	76	2	73	80	7
66	In vitro DM digestibili	%	83				1
67							
68	Dry matter degradabi	%	63		62	75	4
69	Dry matter degradabi	%	69				
70	a (DM)	%	31		22	39	3
71	b (DM)	%	56		46	71	3
72	c (DM)	h-1	0.079		0.061	0.09	3
73							
74	Rabbit nutritive value	Unit	Avg	SD	Min	Max	Nb
75	DE rabbit	MJ/kg DM	10.6				
76	MEn rabbit	MJ/kg DM	9.9				
77	Energy digestibility, ra	%	58.5				
78	Nitrogen digestibility,	%	69.7				
79							

Dry leaves Alfalfa vs Morus alba comparison 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Alfalfa, dehydrated		https://www.feedipedia.org/node/11744						White mulberry (Mora alba) leaf meal		https://www.feedipedia.org/node/26049				
2															
3	Main analysis	Unit	Avg	SD	Min	Max	Nb		Main analysis	Unit	Avg	SD	Min	Max	Nb
4	Dry matter	% as fed	90.6	1.3	84.9	96	15014		Dry matter	% as fed	90.5	3.3	84.5	94.7	7
5	Crude protein	% DM	18.3	2.1	13.1	27.9	14989		Crude protein	% DM	18	2.6	13.6	20.4	8
6	Crude fibre	% DM	28.6	3.7	15.7	38.5	13571		Crude fibre	% DM	13.7				
7	NDF	% DM	45.9	4.6	32.3	54.7	1017		Neutral detergent fibr	% DM	37	13.1	26.2	59.5	6
8	ADF	% DM	32.7	4	22	41.5	1020		Acid detergent fibre	% DM	25.1		23	27.2	2
9	Lignin	% DM	8.5	1.3	5.4	11.8	832		Lignin	% DM	6.1				1
10	Ether extract	% DM	2.7	0.6	1.5	4.4	1089		Ether extract	% DM	3.5		3.2	3.9	3
11	Ash	% DM	11.7	1.4	8.1	16.8	5848		Ash	% DM	12.8	4.5	4.9	17.7	8
12	Starch (polarimetry)	% DM	3.3	0.6	2.1	4.2	60		Starch (polarimetry)	% DM	0				
13	Total sugars	% DM	4.5	1.2	1.9	6.9	46		Total sugars	% DM	12.1				1
14	Gross energy	MJ/kg DM	18	0.4	17.8	19	42		Gross energy	MJ/kg DM	17.5				1
15															
16	Minerals	Unit	Avg	SD	Min	Max	Nb		Minerals	Unit	Avg	SD	Min	Max	Nb
17	Calcium	g/kg DM	22.1	4.1	11.5	33.6	2224		Calcium	g/kg DM	42.3				1
18	Phosphorus	g/kg DM	2.7	0.4	1.8	3.8	1818		Phosphorus	g/kg DM	4.2				1
19	Potassium	g/kg DM	25.6	3.3	17.1	31.7	105		Potassium	g/kg DM	21.7				1
20	Sodium	g/kg DM	0.2	0.1	0.1	0.5	123		Sodium	g/kg DM	1.2				1
21	Magnesium	g/kg DM	2.1	0.5	1.5	3.4	176		Magnesium	g/kg DM	4.7				1
22	Manganese	mg/kg DM	32	12	17	60	40								
23	Zinc	mg/kg DM	30	12	18	64	114		Secondary metabolite	Unit	Avg	SD	Min	Max	Nb
24	Copper	mg/kg DM	6	2	2	11	96		Tanins, condensed (eq	g/kg DM	30				1
25	Iron	mg/kg DM	544	274	223	1084	29		Bioflavonoids						

Dry leaves Alfalfa vs Morus alba comparison 2

27	Amino acids	Unit	Avg	SD	Min	Max	Nb		Amino acids	Unit	Avg	SD	Min	Max	Nb
28	Alanine	% protein	5.1	0.8	3.9	6.5	27		Alanine	g/16g N	5.1		3.7	6.5	2
29	Arginine	% protein	4.5	0.7	3.1	5.5	28		Arginine	g/16g N	7.4		5.8	8.9	2
30	Aspartic acid	% protein	10.2	1.5	7.8	12.8	28		Aspartic acid	g/16g N	8.8		6.4	11.2	2
31	Glutamic acid	% protein	9.7	1	8	12.1	28		Glutamic acid	g/16g N	8.9		8.7	9	2
32	Glycine	% protein	4.5	0.5	3.8	5.7	28		Glycine	g/16g N	4.8		4.1	5.6	2
33	Histidine	% protein	1.5	0.4	1	2.2	23		Histidine	g/16g N	2.2		2.1	2.3	2
34	Isoleucine	% protein	4.1	0.4	3.4	5.2	24		Isoleucine	g/16g N	3.6		2.6	4.6	2
35	Leucine	% protein	7.3	0.7	6.2	8.6	24		Leucine	g/16g N	7.6		6.4	8.8	2
36	Lysine	% protein	4.7	0.5	3.6	5.7	44		Lysine	g/16g N	4.2		4.2	4.3	2
37	Methionine	% protein	1.2	0.3	0.7	1.6	23		Methionine	g/16g N	1.9		1.8	2	2
38	Phenylalanine	% protein	4.6	0.4	3.8	5.4	22		Phenylalanine	g/16g N	3.8		3.5	4	2
39	Proline	% protein	4.3	0.5	3.5	5.3	17		Proline	g/16g N	4.4		4.3	4.4	2
40	Serine	% protein	4.2	0.3	3.8	4.7	16		Serine	g/16g N	4.6		2.8	6.4	2
41	Threonine	% protein	4	0.4	3.4	4.8	18		Threonine	g/16g N	3.9		2.8	5	2
42	Tryptophan	% protein	1.2	0.1	0.9	1.5	17		Tyrosine	g/16g N	3.8		3.6	4	2
43	Tyrosine	% protein	3.3	0.9	1.5	6	18		Valine	g/16g N	5.6		5.4	5.7	2
44	Valine	% protein	6.3	1	4.3	7.6	30								
45	Cystine	% protein	1.1	0.3	0.5	1.5	14								
46															

Dry leaves Alfalfa vs Morus alba comparison 3

49	Ruminant nutritive va	Unit	Avg	SD	Min	Max	Nb		Ruminants nutritive va	Unit	Avg	SD	Min	Max	Nb
50	OM digestibility, Rumi	%	63.3	6.4	53.9	71.6	6		OM digestibility, rumin	%	76.4				1
51	Energy digestibility, ru	%	59.8	5.8	56.2	70.4	6		Energy digestibility, ru	%	73.1				
52	DE ruminants	MJ/kg DM	10.7						DE ruminants	MJ/kg DM	12.8				
53	ME ruminants	MJ/kg DM	8.5	1.4	8.3	11.5	6		ME ruminants	MJ/kg DM	10.4				
54	Nitrogen digestibility,	%	70.2	5.8	63.8	79.4	5		Nitrogen digestibility,	%	64.1				1
55	Nitrogen degradabilit	%	63	3	58	67	12								
56															
57	Pig nutritive values	Unit	Avg	SD	Min	Max	Nb		Pig nutritive values	Unit	Avg	SD	Min	Max	Nb
58	Energy digestibility, gr	%	45.2						Energy digestibility, gr	%	62.9				
59	DE growing pig	MJ/kg DM	8.1						DE growing pig	MJ/kg DM	11				
60	MEn growing pig	MJ/kg DM	7.4						MEn growing pig	MJ/kg DM	10.2				
61	NE growing pig	MJ/kg DM	4						Nitrogen digestibility,	%	81.1				1
62	Nitrogen digestibility,	%	39.6				1								
63															
64	Poultry nutritive value	Unit	Avg	SD	Min	Max	Nb		Poultry nutritive value	Unit	Avg	SD	Min	Max	Nb
65	AMEn cockerel	MJ/kg DM	3.8				1		AMEn cockerel	MJ/kg DM	5.7				
66									AMEn broiler	MJ/kg DM	5.6				
67															
68	Rabbit nutritive value	Unit	Avg	SD	Min	Max	Nb		Rabbit nutritive values	Unit	Avg	SD	Min	Max	Nb
69	Energy digestibility, ra	%	46.4	4.3	40.9	51	6		Energy digestibility, ral	%	56.1				1
70	DE rabbit	MJ/kg DM	8.3	0.8	7.3	9.3	6		DE rabbit	MJ/kg DM	9.8				
71	MEn rabbit	MJ/kg DM	7.7						MEn rabbit	MJ/kg DM	9.2				
72	Nitrogen digestibility,	%	62.2	5.3	51.5	66.6	7		Nitrogen digestibility,	%	68.5				1
73															
74	Fish nutritive values	Unit	Avg	SD	Min	Max	Nb								
75	DE salmonids	MJ/kg DM	7.7												
76	Energy digestibility, sa	%	43				1								
77	Nitrogen digestibility,	%	87				1								

MLs and ML Flavonoids effects

	A	B	C	D
1	Table 4. Effect of mulberry leaf biomass and its flavonoids on ruminant performance.	https://www.mdpi.com/2076-2615/10/11/2076		
2	Animal	Dose Rate	Major Findings	References
3				
4	Fattening Hu sheep	Inclusion of MLP at 15, 30, 45, or 60% in concentrate diet	DM intake and average daily gain was optimized up to 30% MLP	[37]
5	Calves	MLFs at 2 and 4 g/d during pre and post-weaning respectively	Improved growth performance and feed digestibility	[144]
6	Ewes	2 g of MLFs in forage diet (6 weeks)	Reduction in CH4 emission by 12%	[161]
7	steers	Ensiled MLs (16 weeks)	Higher abundance of Ruminococcus albus and Ruminococcus albus in the fecal sample	[162]
8	Simmental crossbred	Corn grain and cottonseed meal diet replaced by 8% ensiled MLs	The concentration of total VFA improved with ensiled MLs compared to sun-dried	[21]
9	Simmental crossbred	Corn grain and cottonseed meal diet replaced by 8% ensiled MLs	Bacterial community composition was similar among the three groups	[163]
10	Beef cattle	Mulberry leaf pellet supplementation at 200, 400, and 600 g/d with	Improved DM intake, ruminal NH3-N, and cellulolytic bacteria	[158]
11	Beef cattle	Mulberry leaf pellet supplementation at 200, 400, and 600 g/d with	Improved apparent metabolizable energy of DM, CP, organic matter, NDF and ADF	[164]
12	Sheep	Basel diet supplemented with 2 g of MLFs	Reduced energy losses of CH4 emission	[7]
13	Sheep	Mulberry foliage 1.2% of body weight	Improved total VFA concentration and digestibility of ADF and NDF	[140]
14	Goats	Feeding of different tree leaves (Azadirachta indica, Melia azedarach,	Morus alba show higher DM intake and digestibility coefficients	[159]
15	Growing lambs	Replacement of rapeseed meal with MLs in ammoniated rice straw	Improved feed intake and growth rate	[16]
16	Goats	50% replacement of conventional supplements with a mixture of leaf	Improved DM intake and comparable nitrogen balance with soybean meal group	[160]
17	Cattle	Compare different grasses (Bermuda grass, elephant grass, and	Improved digestibility of DM and OM and ME and NE value of the ML compare to other	[51]
18	Holstein calves challenged with E. coli	5% mulberry flavonoids at 3 g/d (36 days)	Improved feed efficiency and gut beneficial bacterial Count	[147]
19	Calves	MLFs at 3 g/d during pre- and post-weaning period (21–80 d of age)	The ADG was improved post-weaning and overall period with similar feed Intake	[145]
20	Calves challenged with E. coli	MLFs at 3 g/d	Improved ADG and feed efficiency and reduce oxidative stress	[18]
21	Buffalo	MLFs at 15, 30, and 45 g/d	Dose-dependent increase in milk yield; while a higher level of MLFs also increased milk	[152]
22	Dairy cows	Paper mulberry silage at 13.5% and 18.0%	Increased milk urea nitrogen and decreased somatic cell count with similar milk yield,	[10]
23				
24	MLs = mulberry leaves, MLFs = mulberry leaf flavonoids, MLP = mulberry leaf powder, ADG = average daily gain, DM = dry matter, OM = organic matter, ME = metabolizable energy, NE = net energy, ADF = acid detergent fiber, NDF = neutral detergent fiber, VFA = volatile fatty acid, CH4 = methane.			

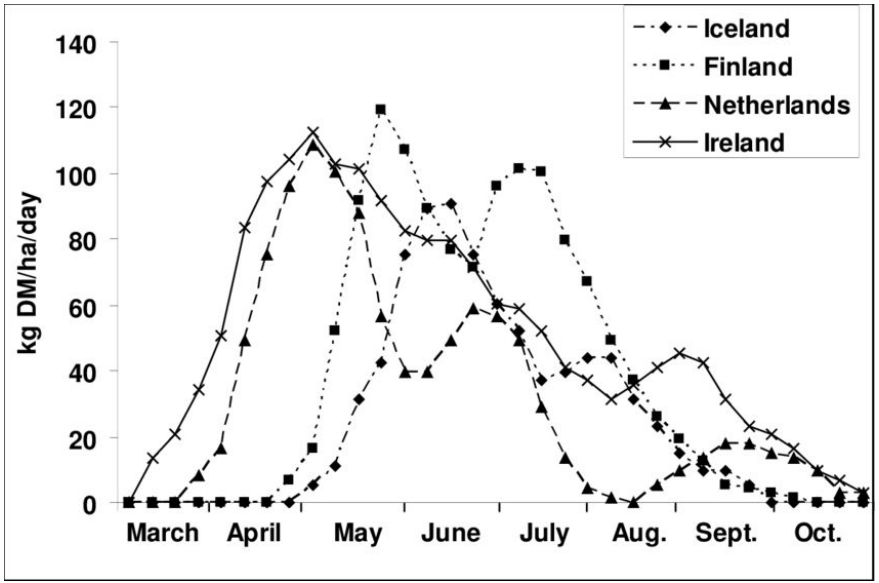
Fresh leaves Alfalfa vs Salix matsudana x alba comparison 1

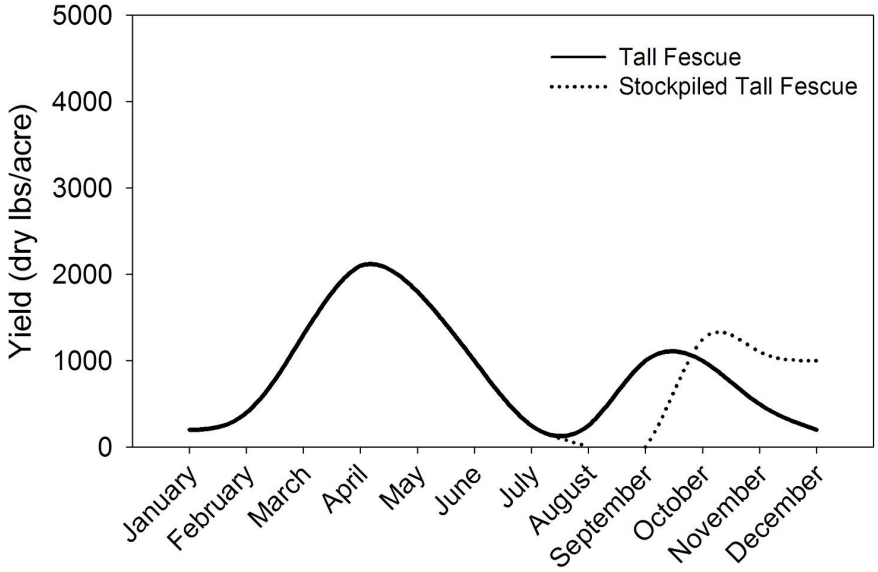
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Alfalfa, aerial part, fresh		https://www.feedipedia.org/node/275						Willow, (S. matsudana x alba) leaves		https://www.feedipedia.org/node/12764				
2															
3	Main analysis	Unit	Avg	SD	Min	Max	Nb		Main analysis	Unit	Avg	SD	Min	Max	Nb
4	Dry matter	% as fed	19.9	3.1	14.1	33.3	1277		Dry matter	% as fed	33.8				
5	Crude protein	% DM	20.6	3.4	12	31.8	1832		Crude protein	% DM	17.7		15	21	https://mr
6	Crude fibre	% DM	26.7	4.1	15.6	38.2	1187		Crude fibre	% DM	14.8				https://mr
7	NDF	% DM	39.3	6.3	25	59.6	1305		Neutral detergent fib	% DM	25		21	33	https://mr
8	ADF	% DM	30.9	5	18.4	44.8	1451		Acid detergent fibre	% DM	22				https://mr
9	Lignin	% DM	7.6	1.8	3.5	12.6	1224		Lignin	% DM					
10	Ether extract	% DM	2.9	0.7	1.4	4.9	1058		Ether extract	% DM	4				https://mr
11	Ash	% DM	11.5	1.9	7.5	19.7	1484		Ash	% DM	9.7		7.5	11.8	https://mr
12	Gross energy	MJ/kg DM	18.1	1	16.7	19.4	7		Gross energy	MJ/kg DM	12				https://mrc
13	Starch (polarimetry)	% DM	0.3				1		Insoluble ash	% DM					
14	Water-soluble carbol	% DM	5.6	1.5	3.4	8.1	10		Water-soluble carbol	% DM	16				https://ww
15															
16	Minerals	Unit	Avg	SD	Min	Max	Nb		Minerals	Unit	Avg	SD	Min	Max	Nb
17	Calcium	g/kg DM	19.4	3.3	10.9	27.6	1095		Calcium	g/kg DM	11.8				
18	Phosphorus	g/kg DM	2.5	0.6	1	5.2	1195		Phosphorus	g/kg DM	4.2				
19	Potassium	g/kg DM	22.4	6.3	13.2	34.6	100		Potassium	g/kg DM	19				
20	Sodium	g/kg DM	0.5	0.2	0.1	1	71		Sodium	g/kg DM	0.2				
21	Magnesium	g/kg DM	2.8	0.8	1.7	4.8	875		Magnesium	g/kg DM	2.8				
22	Manganese	mg/kg DM	76	63	24	246	100		Manganese	mg/kg DM	272				
23	Zinc	mg/kg DM	43	31	17	176	57		Zinc	mg/kg DM	386.2		Anti inflammatory		
24	Copper	mg/kg DM	13	3	8	20	59		Copper	mg/kg DM	8				
25	Iron	mg/kg DM	387	251	122	1121	106		Iron	mg/kg DM	104.8				
26									Selenium	mg/kg DM	0				
27									Sulfur	g/kg DM	3.8				
28									Secondary metabolite	Unit	Avg	SD	Min	Max	Nb
29									Tanins, condensed (e	g/kg DM	40		10	65	https://mrc
30									phenolic glycosides (e	g/kg DM	5				https://ww

Fresh leaves Alfalfa vs Populus nigra x deltoides comparison 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Alfalfa, aerial part, fresh		https://www.feedipedia.org/node/275						Populus nigra x deltoides		https://www.feedipedia.org/node/12764				
2															
3	Main analysis	Unit	Avg	SD	Min	Max	Nb		Main analysis	Unit	Avg	SD	Min	Max	Nb
4	Dry matter	% as fed	19.9	3.1	14.1	33.3	1277		Dry matter	% as fed					
5	Crude protein	% DM	20.6	3.4	12	31.8	1832		Crude protein	% DM	14.77				https://wv
6	Crude fibre	% DM	26.7	4.1	15.6	38.2	1187		Crude fibre	% DM					
7	NDF	% DM	39.3	6.3	25	59.6	1305		Neutral detergent fibr	% DM	42.09				https://wv
8	ADF	% DM	30.9	5	18.4	44.8	1451		Acid detergent fibre	% DM	29.26				https://wv
9	Lignin	% DM	7.6	1.8	3.5	12.6	1224		Lignin	% DM					
10	Ether extract	% DM	2.9	0.7	1.4	4.9	1058		Ether extract	% DM					
11	Ash	% DM	11.5	1.9	7.5	19.7	1484		Ash	% DM	7.8				https://wv
12	Gross energy	MJ/kg DM	18.1	1	16.7	19.4	7		Gross energy	MJ/kg DM	12				https://mr
13	Starch (polarimetry)	% DM	0.3				1		Insoluble ash	% DM					
14			5.6	1.5	3.4	8.1	10		Water-soluble carboh	% DM	19				https://ww
15															
16	Minerals	Unit	Avg	SD	Min	Max	Nb		Minerals	Unit	Avg	SD	Min	Max	Nb
17	Calcium	g/kg DM	19.4	3.3	10.9	27.6	1095		Calcium	g/kg DM	12.6				https://mr
18	Phosphorus	g/kg DM	2.5	0.6	1	5.2	1195		Phosphorus	g/kg DM	2.2				Guevaria-E
19	Potassium	g/kg DM	22.4	6.3	13.2	34.6	100		Potassium	g/kg DM	25.3				
20	Sodium	g/kg DM	0.5	0.2	0.1	1	71		Sodium	g/kg DM	0.8				
21	Magnesium	g/kg DM	2.8	0.8	1.7	4.8	875		Magnesium	g/kg DM	4.4				
22	Manganese	mg/kg DM	76	63	24	246	100		Manganese	mg/kg DM	134				
23	Zinc	mg/kg DM	43	31	17	176	57		Zinc	mg/kg DM	157				
24	Copper	mg/kg DM	13	3	8	20	59		Copper	mg/kg DM	10				
25	Iron	mg/kg DM	387	251	122	1121	106		Iron	mg/kg DM	242				
26									Selenium	mg/kg DM					
27									Sulfur	g/kg DM	4				
28									Secondary metabolite	Unit	Avg	SD	Min	Max	Nb
29									Tanins, condensed (ec	g/kg DM	15		3	20	https://ww
30									phenolic glycosides (e	g/kg DM	17				https://ww

Pasture growth dynamics in Europe



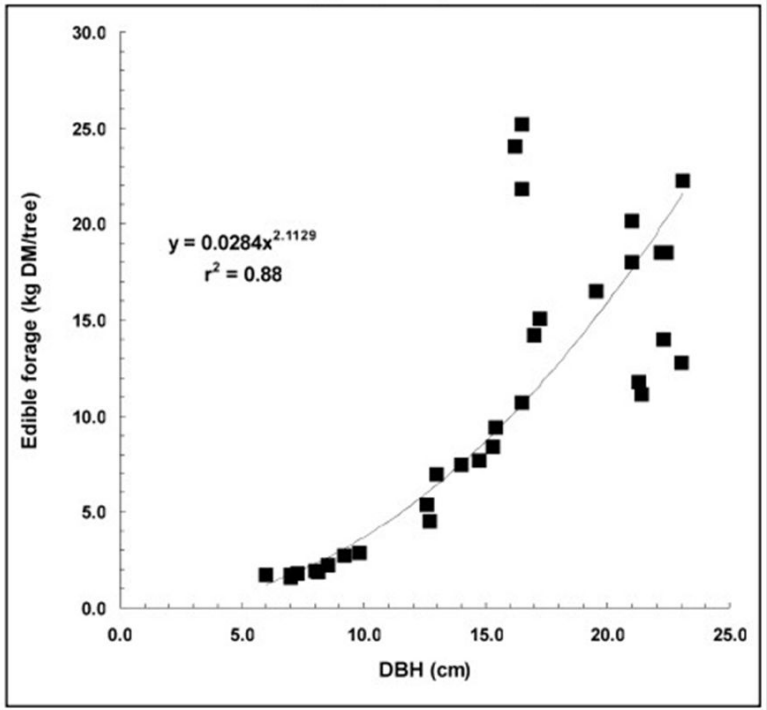


https://extension.uga.edu/publications/detail.html?number=B1351

Herbage Growth Models as Aids for Managing Intensively Grazed Grassland in Western Europe https://www.researchgate.net/publication/267853330_Herbage_Growth_Models_as_Aids_for_Managing_Intensively_Grazed_Grassland_in_Western_Europe

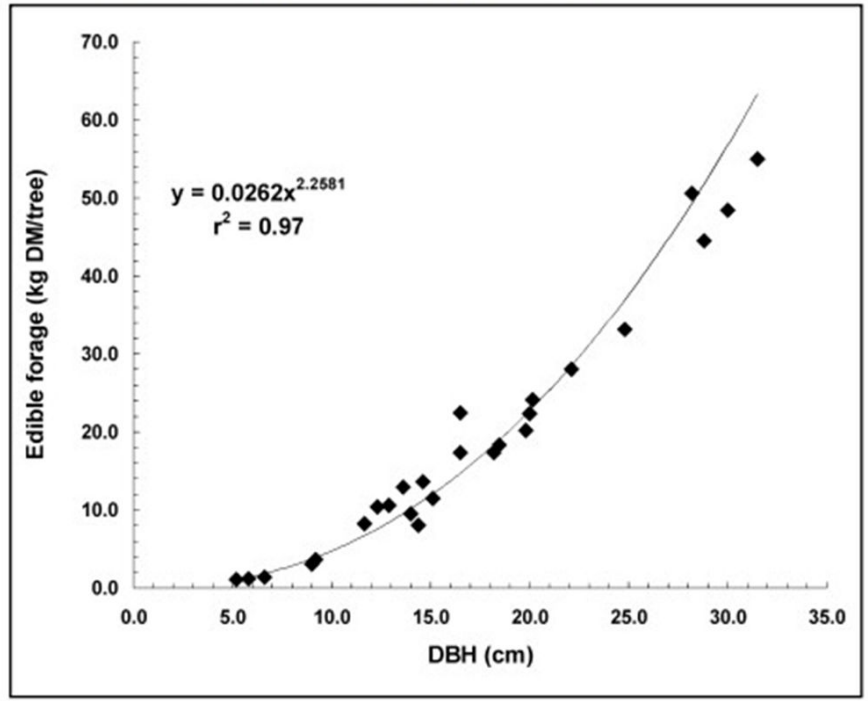
Yield

Figure 1. Relationship between diameter at breast height (1.4 m, DBH) of the tree trunk and the forage mass per tree based on leaves plus stems < 5 mm diameter for Veronese poplar (n = 32, p < 0.001).



https://www.grassland.org.nz/publications/nzgrassland_publication_2609.pdf

Figure 2. Relationship between diameter at breast height (1.4 m, DBH) of the tree trunk and the forage mass per tree based on leaves plus stems < 5 mm diameter for Tangoio willow (n = 26, p < 0.001).



https://www.grassland.org.nz/publications/nzgrassland_publication_2609.pdf

Planting systems: Fodder blocks - coppice

Planting systems: Low pollard with and without grassed pathways

Planting systems: High pollard systems with pasture underneath

Planting systems: Single trees high pollard incorporated in other systems

Mechanization of harvesting: Universal forage harvester

Mechanization of harvesting: Biomass harvester

Mechanization of harvesting: top and side bar and disc pruner

Animals living the good life

Q & A

I'm happy to chat trees any time!

Find me at: iliarashev@gmail.com