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Renewed interest for silvopastoral systems in Europe – an inventory of the feeding value of fodder trees

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Abstract

The reform of the EU's Common Agricultural Policy (CAP) has created renewed interest in the implementation of agroforestry and silvopastoral systems. The multifunctional use of trees for energy and wood production, nutrient cycling, carbon storage, biodiversity, landscape quality and -last but not least- fodder makes trees a potential third crop next to grass and maize on dairy farms. To decide which trees to use for planting, it is important to have insight into the feeding value of the different species. Therefore we created a database on feeding values of leaves and twigs, using data from the literature. These data show that, compared to grass, the in-vitro organic matter digestibility of tree leaves is relatively low. However, crude protein and mineral levels of some species are relatively high, which shows the potential value of tree leaves as an additional feed source.

Introduction

The reform of the EU's Common Agricultural Policy (CAP), has created renewed interest in agroforestry and silvopastoral systems. The CAP includes several "greening measures" aimed to enhance biodiversity on farmland, such as creating Ecological Focus Areas (EFA) and requiring farmers to grow at least three crops on their farms. The multifunctional use of trees for energy and wood production, nutrient cycling, carbon storage, biodiversity and -last but not least- fodder, makes trees an interesting candidate to grow as a third crop on Dutch dairy farms, next to grass and maize. Theintroduction of fodder trees on dairy farms requires insight into the cultivation, harvest, production and feeding value of different species. The objective of this survey was to create a database of feeding values (energy, protein and mineral levels) of common tree species, and compare these data to the feeding value of grass (*Lolium perenne* L.).

Material and methods

Based on a literature review, records about the feeding value of leaves and twigs from temperate tree species were collected in a database (www.voederbomen.nl). The database includes studies from Germany (Becker and Nehring 1965, Rahmann 2004), the UK (Smith et al. 2012), the Netherlands (Van Eekeren unpublished), France (Trémolières 1999), Finland (Saramäki and Hytönen 2004), Greece (Papachristou and Papanastasis 1994) and studies from outside Europe (Burner et al. 2005, Chen et al. 2011, Roder 1992, Singh et al. 1997). The database includes records of tree leaves, twigs, and twigs with leaves of 40 different temperate tree species (620 records in total). Using this database, we compared the nutritive value of the leaves of a number of temperate fodder trees: alder (*Alnus glutinosa* L. Gaertn.), birch (*Betula pendula* Roth), hazel (*Corylus avellana* L.), beech (*Fagus sylvatica* L.), ash (*Fraxinus exelsior* L.), robinia (*Robinia pseudoacacia* L.), large-leaved lime (*Tilia platyphyllos* Scop.), and willow (*Salix alba* L.). The nutritive values for grass (*Lolium perenne* L.) are shown for comparison.

Results

The literature study showed that there are ample data available on feeding values of temperate fodder trees. Compared to grass, the in-vitro organic matter digestibility (OMD) of the different tree leaves is generally low (averages ranging from 30.6 to 57.8% for tree leaves, compared to 79% for grass) (Table 1). This is probably related to the high lignin and fiber content of tree leaves and/or the presence of secondary plant compounds such as tannins. Crude protein levels of the different tree species range from 15.7 to 21.4% of DM (Table 2). Some species, particularly lime tree (*T. platyphyllos*) and robinia (*R. pseudoacaccia*) have a higher average crude protein content than perennial rye grass in the Netherlands (16.5%). Average copper levels in tree leaves range from 7.7 to 15.3 mg kg-1 for the different species, compared to 8.9 mg kg-1 in grass (Table 3). Particularly hazel and beech leaves contain high levels of copper. This mineral is of interest because in the

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Netherlands it is often lacking in the roughage for lactating cows and goats, and especially growing young stock.

Table 1: In-vitro Organic Matter Digestibility (%) of tree leaves. Average (av), minimum (min), maximum (max) values and number of records (n) found in the literature.

Species	Common name	Av	Min	Max	n
Alnus glutinosa	Alder	48.1	10.4	69.1	6
Betulus pendula	Birch	37.6	5.9	63	3
Corylus avellana	Hazel	47.7	46.4	50.0	3
Fagus sylvatica	Beech	30.7	7.4	59.0	5
Fraxinus excelsior	Ash	34.1	12.8	55.3	2
Robinia pseudoacacia	Robinia	56.7	37.3	77.4	7
Salix spp.	Willow	57.8	4.5	70.5	5
Tilia platyphyllos	Large-leaved Lime	30.6	15.0	46.2	2
Lolium perenne	Grass	79.0			

Table 2: Crude protein levels in tree leaves (% of DM). Average (av), minimum (min), maximum (max) values and number of records (n) found in the literature.

Species	Common name	Av	Min	Max	n
Alnus glutinosa	Alder	19.2	14.4	26.2	6
Betulus pendula	Birch	17.5	14.0	22.9	5
Corylus avellana	Hazel	16.1	14.1	20.4	7
Fagus sylvatica	Beech	18.0	14.3	23.3	18
Fraxinus excelsior	Ash	15.7	5.9	26.8	8
Robinia pseudoacacia	Robinia	20.4	11.6	27.0	16
Salix spp.	Willow	15.9	9.8	23.1	10
Tilia platyphyllos	Large-leaved Lime	21.4	15.3	28.0	13
Lolium perenne	Grass	16.5			

Table 3: Copper levels in tree leaves (mg kg-1 DM). Average (av), minimum (min), maximum (max) values and number of records (n) found in the literature.

Species	Common name	Av	Min	Max	n
Alnus glutinosa	Alder	12.3	6.0	20.0	4
Betulus pendula	Birch	10.0	10.0	10.0	1
Corylus avellana	Hazel	13.1	8.5	18.0	4
Fagus sylvatica	Beech	15.3	6.5	24.0	2
Fraxinus excelsior	Ash	10.0	10.0	10.0	1
Robinia pseudoacacia	Robinia	7.7	7.0	8.3	2
Salix spp.	Willow	8.3	5.5	12.9	5
Tilia platyphyllos	Large-leaved Lime	8.0	8.0	8.0	1
Lolium perenne	Grass	8.9			

Discussion

Our analysis shows that various tree species are very interesting in terms of feeding value for livestock. Tree leaves could serve as alternative source of proteins, minerals and spore elements. However, the records in the database show a considerable range in feeding values for the same tree species. This range is probably due to seasonal differences (Smith et al. 2012), local soil conditions (Saramäki and Hytönen 2004, Wroblewska et al. 2009) and the ability of tree species to adapt to local conditions (Robinson 2005). Unfortunately, most studies did not record the soil conditions. Therefore we are now conducting a follow-up study to investigate the relation between feeding value of fodder trees and harvest date, soil type and soil fertility.

Suggestions to tackle with the future challenges of organic animal husbandry

Trees deliver a range of ecosystem services. The challenge for modern organic farmers is to make optimal use of the multi-functionality of trees, fine-tuned to the specific farming system and local conditions. The use of tree leaves as an alternative fodder crop is just one of the functions of trees on farms. Optimising this function with other uses (such as energy and wood production, and stimulation of functional biodiversity) could make trees a profitable crop for organic farming systems.

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