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YELLOW-FLOWERED LUCERNE (*MEDICAGO FALCATA* L.)

- A POTENTIAL FORAGE LEGUME FOR THE NORTH

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Abstract

The suitability of yellow-flowered lucerne (*Medicago falcata* L.) for forage production under the northern conditions was studied in a mixture sward with timothy (*Phleum pratense* L.) in field trials in South Finland for four years from 1995 to 1998. Through the first three winters lucerne stayed unharmed. In June and July lucerne grew vigorously, but in August little. The total seasonal yields were highest in the second and the third year of harvesting, up to 10 t DM ha^{-1}. In the winter 1997-1998 , winter damages killed 21 to 38 % of lucerne plants, and resulted yield decrease next summer. Lucerne did not respond to nitrogen fertilization up to 90 kg N ha^{-1}. Contents of crude protein, Ca, Mg and K of yield were higher, crude fat and P similar, crude protein content even higher compared to timothy.

Keywords: yellow-flowered lucerne, persistence, yields, harvesting time, quality

Introduction

Yellow-flowered lucerne (*Medicago falcata* L.), which is endemic up to the latitude 62°N and known to be winterhardy (Lesins, 1979), has been studied as a new potential forage legume for Finland since 1988. Today its agricultural importance is limited to Estonia, where it is grown in pastures. Its good persistence in South Finland (Mela *et al*., 1996) motivated new field

experiments on agronomic characteristics as well as animal studies. Compared to grass silage, intake of lucerne-grass silage of dairy cows was higher, but milk production similar (Heikkilä *et al.*, 2000). According to Sormunen-Cristian *et al*. (1998, 2000) ewes preferred lucerne silage to grass silage. The amount of phyto-oestrogens in yellow-flowered lucerne did not affect on the conception rates and lambing performance of ewes.

Materials and Methods

A yellow-flowered lucerne (*Medicago falcata* L., the seed originated from Estonia) - timothy (*Phleum pratensis* L. cv. Iki bred by Jokioinen Plant Breeding Institute) sward was established at the Agricultural Research Centre, Jokioinen, South Finland (60°49'N, 23°30'E). The seed mixture included lucerne 20 kg ha $^{-1}$ and timothy 10 kg ha^{-1}. At sowing, 12 kg ha^{-1}N, 48 kg ha^{-1} P and 56 kg ha^{-1} K were given as compound fertilizer. Two field experiments were conducted, both with randomized complete-block design and four replicates. In Experiment 1, the effects of four sequential cutting times (A, B, C, D) of the first harvest on herbage yield and quality were studied. The schema for the cuttings in a season was as following (dates for 1995, 1996, 1997, and 1998 in the corresponding order):

	1st cut	2nd cut	3rd cut
A	June 8,10,11,15----------	August 15,12,15,3----------	Sept. 18,10,12,17
B	June 15,26,23,22----------	- A -	---------- - A -
C	June 28, July 10,7,2---------- A -	----------	- A -
D	July 13,17,15,9-------- A -	----------	- A -

The 1st cut of A treatment was targeted to the bud stage of lucerne flower heads, the 1st cut of B treatment to the start of flowering. In Experiment 1, each May from 1995 to 1998, the sward was fertilized with 30N-19P-21K kg ha^{-1} in compound fertilizer. In Experiment 2, nitrogen

treatments of 0, 30, 60 and 90 kg N ha^{-1} were compared, all plots were fertilized with 36 kg ha^{-1} P and 42 kg ha^{-1} K. Plot size of both the experiments was 15 m^2. Lucerne and timothy components of herbage samples were analyzed separately with conventional methods.

Growth conditions. The soil type was heavy clay, pH 6,42, Ca 3734 mg l^{-1}, Mg 838 mg l^{-1}, P 21,0 mg l^{-1}, K 300 mg l^{-1}. Common for the most of the years was wet spring and/or beginning of summer but dry August and September. This was favourable for the growth of forage crops which had enough water available for their most vigorous growing period.

Results and Discussion

During the three first winters yellow-flowered lucerne did not suffer winterdamages at all. Already the young sward gave abundant yields in the rainy and warm spring 1995 (Table 1). In the second and third year, which also were favourable for forage growth, the total yields were at the highest. The growth was largest in June 1996, between harvests A and B it was 384 kg DM ha^{-1} day^{-1}, between B and D 252 kg DM ha^{-1} day^{-1}. In 1997 the corresponding figures were 252 kg and 136 kg. In the winter 1997-1998 average winter damages grew to as high as 21 to 38 % of plants died. As a result forage yields were decreased next summer and weeds occupied a major part, 20-30 %, of the yield.

During the first three seasons yellow-flowered lucerne grew very vigorously and occupied growth space from timothy. Only a few grass leaves could be seen in the regrowth sward in 1997. Means for better grass-legume mixtures are: to select a grass with stronger regrowth than timothy, to increase the share of grass in seed and to give nitrogen fertilization for each cut. Experiment 2 demonstrated the effect of nitrogen with 70 to 115 % higher seasonal yields compared to those harvested in Experiment 1 in 1998. In the earlier years, when lucerne grew well, amount of N -fertilization did not affect the yields, which tells that there were *Rhizobium* -strains in the soil which were suitable for symbiosis with yellow-flowered lucerne.

Total seasonal yields of yellow-flowered lucerne - timothy swards were comparable to yields of abundantly with nitrogen fertilized grass in Finland. In three year three cut trials red clover yielded 2880 kg DM ha^{-1} (Mela *et al*., 1980), in another group of similar trials 4300 kg DM ha^{-1} (Mela, unpublished data), but the average lucerne yield (grass not included) of corresponding treatment B was 6300 kg DM ha^{-1}. Thus, because of stronger regrowth, lucerne may suit for swards for silage and pasture better than red clover. An advantage of yellow-flowered lucerne compared to red clover is deep roots and better drought resistance.

Protein, Ca, Mg and K contents of lucerne were high compared to grass (Table 2), crude fat and P contents were similar. Crude fibre content was high, in some cases higher or equal to timothy. Crude fibre content of red clover has been in a three cut system 21-23 % at the highest (Mela, unpublished data).

In conclusion, yellow-flowered lucerne stayed unharmed through the first three winters but damages were heavy in the fourth winter. The crop grew vigorously and occupied growth space from timothy. The growth concentrated in the beginning of the summer, June and July, in August and September there was little growth. During the first three years total seasonal yields were high, even more than 10 t DM ha^{-1}. Crude fibre content of yellow-flowered lucerne was as high as that of timothy when cut at a late stage of growth.

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Table 1 - Dry matter yields of harvesting time experiments by years and cuts

Treatment	1995				1996			
	1st	2nd	3rd	Sum	1st	2nd	3rd	Sum
A	3030	3200	590	6820	2930	5130	450	8510
B	3570	2470	530	6570	6160	2690	430	9280
C	5020	1620	550	7190	8660	1450	520	10630
D	4950	990	380	6320	9000	500	770	10270
F-values				2,4				7,5**
	1997				1998			
	1st	2nd	3rd	Sum	1st	2nd	3rd	Sum
A	2050	5220	880	8150	1740	2220	260	4220
B	5080	4810	710	10600	1750	1470	210	3430
C	6980	2830	460	10270	3180	1240	250	4670
D	7720	2780	560	11060	3380	520	200	4100
F-values				12,6**				1,5

Table 2 - Chemical composition of yellow-flowered lucerne and timothy fractions of yields. Each figure is a mean of 12 analysis (8 analyses if marked with !) of the years 1996, 1997 and 1998.

Species	Treatments											
	1st cut				2nd cut				3rd cut			
	A	B	C	D	A	B	C	D	A	B	C	D
					Crude protein, %							
Lucerne	25.1	21.2	17.9	16.6	20.4	22.8	25.3	28.3	30.9	31.9	32.8	32.5
Timothy	14.5	10.6	8.2	7.2	11.0	16.0	17.3	21.5	20.9	19.2	19.4	19.9
					Crude fibre, %							
Lucerne	19.4	25.9	33.0	34.7	30.8	27.0	22.2	19.9	15.4	14.3	14.6	15.2
Timothy	25.5	32.5	35.4	35.9	28.8	26.1	25.0	22.6	18.8	20.3	22.1	22.1
					Crude fat, %							
Lucerne	2.7	2.5	2.0	1.9	2.1	2.7	2.9	3.1	3.4	3.7	3.6	3.4
Timothy	2.6	2.3	1.8	1.7	2.5	3.5	4.0	4.2	3.5	3.9	3.7	4.0
					Ca, g kg^{-1}							
Lucerne	16.1	14.5	12.0	11.2	12.7	14.2	15.3	15.6	17.9	18.9	19.4	19.6
Timothy	2.5	2.2	2.0	1.9	3.2	3.8	4.2	4.6	4.9	4.4	4.9	4.8
					Mg, g kg^{-1}							
Lucerne	4.2	3.5	2.8	2.6	2.7	3.3	3.5	3.6	3.9	3.8	3.7	43
Timothy	1.3	1.0	1.0	1.0	1.6	1.8	1.9	2.1	2.4	2.2	2.6	2.2
					K, g kg^{-1}							
Lucerne	36.0	30.9	28.0	25.8	27.3	30.3	34.3	37.3	32.5	34.0	32.9	33.6
Timothy	29.7	25.3	20.4	18.7	26.7	34.8	35.6	37.3	31.4	28.5	30.8	31.9
					P, g kg^{-1}							
Lucerne	3.7	3.1	2.8	2.4	2.8	3.0	3.4	4.2	4.1	4.2	4.3	4.2
Timothy	3.8	3.0	2.6	2.3	3.5	4.7	4.9	5.4	4.4	4.1	4.6	4.4