AGRICULTURAL AND FOOD SCIENCE IN FINLAND

Vol. 7 (1998): 437–446.

Yellow-flowered lucerne: properties and influence on performance and reproduction of ewes

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Conception rates and prolificacy of Finnish Landrace ewes fed yellow-flowered lucerne (*Medicago falcata* L.) pasture and silage prior to and during the mating period were compared with those of control ewes fed timothy (*Phleum pratense* L.) – meadow fescue (*Festuca pratensis* Huds.) pasture and silage. Ewes grazed pasture for four weeks and received their respective silage for 10 weeks indoors. Dry matter (DM) intake of lucerne silage was higher than that of grass silage (1.77 vs. 1.40 kg DM day^{-1}). Timothy-fescue grass and silage analysed by a new modified method did not contain detectable amounts of plant oestrogens. In fresh and preserved lucerne, the amount of coumestrol was only moderate varying from zero to 59.5 ppm DM. Ewes fed lucerne received higher amounts of plant oestrogens than those on control feeding, but no differences in conception rate or lambing performance were found between the groups. However on lucerne, ewes conceived five days earlier (P=0.03) than control animals. Prolificacy of lucerne and control fed ewes averaged 3.13 and 3.19 lambs/ewe (P=0.76), respectively. There were no ewe health problems. The results suggest that the intake of yellow-flowered lucerne is good and the level of plant oestrogens has no detrimental effects on reproductive performance of adult Finnish Landrace ewes.

Key words: fertility, forage legume, grazing, mating, *Medicago falcata*, plant oestrogens, sheep

Introduction

A yellow-flowered lucerne (*Medicago falcata* L.), a close relative to alfalfa (*Medicago sativa* L.), is a new cultivated plant among Finnish forage legumes, which in the late 1980s was introduced into Finland from Estonia (Mela et al. 1996). The plant has been found to be endemic in southern and western Finland. Yellow-flow-

Manuscript received July 1998

ered lucerne has adapted well to Finnish growing conditions and is winter hardy (Mela et al. 1996). The nutritional benefits of legumes, especially those of white clover, to improve lamb live weight gains are widely recognized (Davies et al. 1989, Bax and Schils 1993). However, flushing and mating ewes fed lucerne has been reported to result in a reduced lambing rate compared with ewes fed grass pasture (Coop and Clark 1960). Detrimental effects of lucerne have been related to the presence of plant oestrogens (Thomson 1975). Oestrogenic activity of plant oestrogens varies according to the nature of the oestrogenic substance and animal species, even to the level of ewe fecundity (Scales et al. 1977). In ruminants, coumestrol and formononetin are the most active plant oestrogens (Braden et al. 1967) and sheep are more sensitive to their effects than cattle (Lightfoot 1974). The Finnish Landrace breed, which accounts for nearly 80% of the sheep population in Finland, is extremely fertile and prolific having on average 2.8 lambs born per adult ewe per year (Savolainen 1996). In view of the high fecundity, Finnish Landrace ewes are suspected to be sensitive to the effects of plant oestrogens. As far as we know, there are no studies in the literature concerning the oestrogenic properties of yellow-flowered lucerne. Furthermore, since yellow-flowered lucerne has normally been harvested as pasture or hay (Laur 1981), information concerning the chemical composition, quality and palatability of lucerne silage is very sparse. The present study was designed to establish the chemical composition, quality and plant oestrogen content of yellow-flowered lucerne pasture and silage, and the effect of lucerne feeding on oestrus, conception rate and prolificacy of two-year old pure-bred and half-bred Finnish Landrace ewes.

Material and methods

Silage and pasture swards

A yellow-flowered lucerne (*Medicago falcata* L. cv. Karlu, Estonia) - timothy (*Phleum pratense* L. cv. Iki) sward was established on clay soil in 1994 at the Agricultural Research Centre in Jokioinen in South Finland (60°54'N, 23°30'E, 107 m above sea level). The seed mixture used was lucerne 20 kg ha^{-1}/timothy 10 kg ha^{-1}. Lucerne seeds were not inoculated before sowing. At sowing, 12 kg ha^{-1} N, 48 kg ha^{-1} P and 56 kg ha^{-1} K were applied as compound fertilizer. In May 1996, the sward was fertilized with 6, 24 and 28 kg ha^{-1} (N-P-K). Lucerne silage made from a first-growth direct-cut grass was harvested on 26 June 1996 using a flail harvester. Silage was ensiled into the clamp using AIV2 solution (80% formic acid, 2% orthophosphoric acid) at a rate of 5.7 litres t^{-1} grass sprayed on during harvesting. Preservation lasted 74 days. A non-oestrogenic control silage was prepared in June from a direct-cut fescue (*Festuca pratensis* Huds.) - timothy grass and AIV2 solution at a rate 5.2 litres t^{-1}. The regrowths of lucerne and timothy-fescue swards were grazed by ewes.

Before harvesting and grazing, lucerne and timothy-fescue swards were divided into five sub-areas from which samples were taken by cutting six 0.5 x 0.5 m areas to ground level with grass scissors. Sward surface heights were measured using a sward stick.

Animals and their feeding

Thirty-four 2-year old ewes were randomly allocated to two feeding groups, each consisting of ten pure-bred and seven half-bred (Finnish Landrace x Oxford Down) Finnish Landrace ewes. Before their allocation to treatments, ewes had grazed as a group on grass pasture. Feeding group L (lucerne group) grazed on yellow-flowered lucerne-grass pasture (0.5 ha) and feeding group G (grass/control group) on fescue-timothy grass pasture (0.5 ha) for 26 days: 14 August – 9 September. On pasture ewes did not receive any supplementary feed. After grazing, ewe groups were fed indoors in adjacent straw-pedded pens for 70 days: 10 September – 18 November. From the beginning of the indoor feed-

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ing period to the end of mating (10 September – 18 November) L ewes received lucerne silage and G ewes timothy-fescue silage *ad libitum*. Silages were supplemented with 300 g of barley grain per ewe per day for 2 weeks before and during a 5-week mating period (30 September – 18 November). The L and G ewes were exposed to Finnish Landrace rams equipped with a crayon harness (15 October – 18 November). The marked ewes in heat were recorded daily.

After mating, the intake of lucerne and grass silages were compared using eight L and eight G pure- bred Finnish Landrace ewes housed individually in galvanised metal cages (measuring 2.1 x 2.2 m) with three feed-bins and a water nipple. Ewes were offered both silages *ad libitum* to ensure 10% refusals. In addition to roughages, a mineral mixture (Ca/P= 1.2:1) and salt (NaCl) supplements were available *ad libitum*. Feed intake of each ewe was measured for 14 days.

Silage samples were taken at every feeding and pooled over the two week periods. Ewe live weights and body condition scores (Russel et al. 1969) were recorded at the beginning of grazing and indoor feeding periods, at mating, one week before and two days after lambing. Mating dates, birth dates, numbers of lambs born and lamb mortality were recorded.

Analytical methods

For determining botanical composition, 0.5 kg of sample was separated into lucerne, grass and weeds and these subsamples were oven dried at 105°C for 24h. Dry matter (DM) content of fresh and conserved herbage was determined by oven drying at 105°C for 24h. Silage DM content was corrected according to Huida et al. (1986). Proximate composition of silages was analysed by standard procedures (AOAC 1984). In addition, silages were analysed for total and water-soluble nitrogen by the Kjeldahl method, for ammonium nitrogen (McCullough 1967), pH and lactic acid (Barker and Summerson 1941), for volatile fatty acid by gas chromatography (Huhtanen et al. 1998) and for water-soluble carbohydrates (Somogyi 1945). The amounts of neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), hemicellulose and cellulose were determined according to Robertson and Van Soest (1981). Metabolizable energy (ME) content was predicted from digestible organic matter (D-value) content determined by an *in vitro* cellulase-based digestion (Friedel 1990) for grass and silage. Feed unit (FU) was obtained by dividing ME content by 11.7 (Tuori et al. 1996). Protein intake was calculated in terms of amino acids absorbed in the small intestine and protein balance in the rumen (AAT-PBV system, Tuori et al. 1996). In these calculations, it was assumed that 84% of lucerne crude protein was degraded in the rumen (Mela et al. 1996).

The analysis method of plant oestrogens previously described (Saloniemi et al. 1993, Saloniemi et al. 1995) was modified for this study. Analytical conditions for the quantification of plant oestrogens were as follows:

Equipment	Liquid chromatograph-Hewlett Packard 1050, automatic sampler, UV-detector at 262 nm and fluorescence detector 1046A ex. always 254 nm at the beginning em. 462 nm, after 10.60 min. em. 410 nm, after 12.55 min. em. 465 nm HP ChemStation data system
Pre-column	LiChrospher 100 RP-18 5µ 4x 4 mm
Column	Hypersil BDS C-18 5µ 250 x 4 mm
Mobile phase	Acetonitrile/water + 200 µl acetic acid Suprapur Merck/1 L. At the beginning 5%, after 7.7 min. 40%, at 10.5 min. 43%, at 14 min. 50%, at 19 min. 100%, at 22 min. 100% acetonitrile. Run time 22 min., post time 8 min.
Standards	Daidzein 4',7-dihydroxyisoflavone INC Biochemicals Cat.No. 210836 K&K ICN, Coumestrol Eastman Kodak Co. Cat. No. 1342799, Formononetin 7-hydroxy-4'-methoxy-

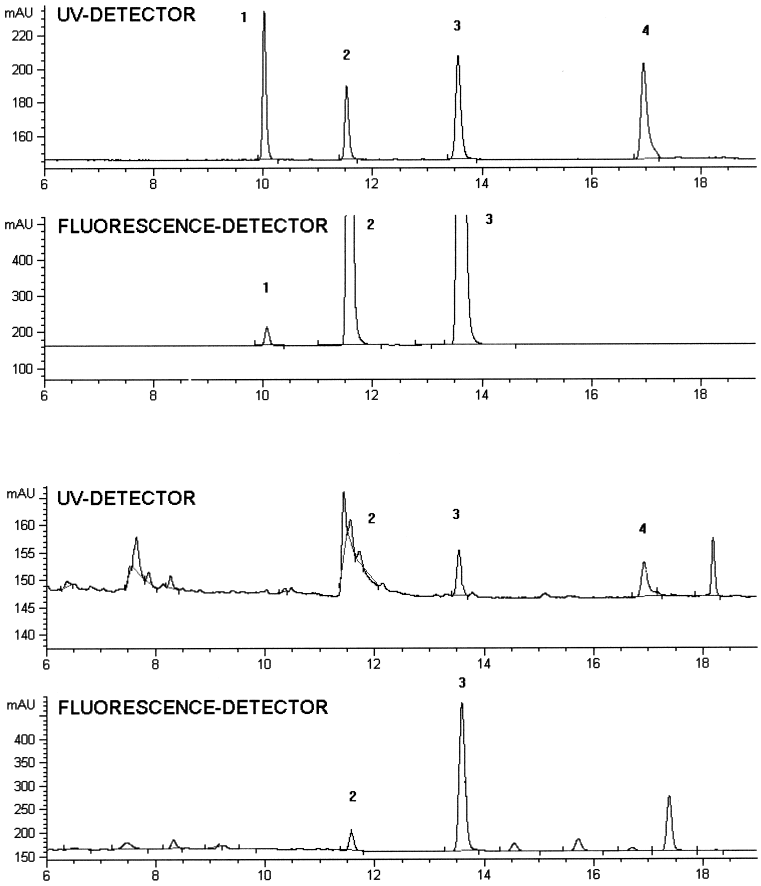

Figure 1. Upper figure pair shows chromatogram of plant oestrogen standards measured with UV and fluorescence detector: 1. Daidzein (125 ng), 2. Coumestrol (125 ng), 3. Formononetin (125 ng) and 4. Biochanin-A (125 ng). Lower figure pair shows chromatogram of lucerne grass sample taken on 6 September. Note in the UV-chromatogram the split peak of coumestrol where two unknown compounds disturb the calculation of concentration. In fluorescence detector these compounds do not fluoresce.

isoflavone Cat. No. 3257 Roth, BiochaninA 5,7-dihydroxy-4'-methoxyisoflavone Aldrich Cat. No. 14,563-7.

Working standard	12.5–0.39 µg/ml
Sample size	10 µl
Flow rate	1 ml/min.
Column temp.	+ 35°C

Samples of fresh and conserved herbage were ground in a meat chopper immediately after cutting, 40 g of the ground sample was transferred into suitable flask and 25 ml of water was added. This mixture was incubated for 30 min. at +37°C to hydrolyze the conjugated phytoestrogens (Beck 1964, Francis and Millington 1965a, Francis and Millington 1965b), and was subsequently mixed with absolute ethanol. Samples were then stored in a refrigerator for later chemical analyses. Five replicate analyses of each sample were performed.

Plant samples were warmed at room temperature and shaken in a bottle for 5 min. This procedure was repeated the next day and samples were filtered through a Büchner funnel with the filtrate being evaporated at +40°C to a volume of 100 ml. An aliquot was diluted and filtered through an Acrodisc CR filter (Gelman) prior to high performance liquid chromatography. Biochanin-A was measured by UV absorbance at retention time 17.3 min. Daidzein, coumestrol and formononetin were measured by fluorescence. The retention times were at 10.1, 11.7 and

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13.6 min., respectively. Examples of plant oestrogen chromatograms are shown in Fig. 1.

Adequacy of the hydrolysis method (Saloniemi et al. 1993) (maceration and incubation for 30 min. at +37°C) was established as follows: the amount of material equal of 2 g dry matter was put in to a reflux bottle and 5 ml of 6.9-M HCl was added. The bottle was then heated for one hour with reflux condenser at +92°C. Finally, pH 5.0 was restored. An aliquot was diluted and filtered prior to high performance liquid chromatography.

Plant oestrogen standard were added at 5 µg/ml into the empty incubation bottle to assess compound recoveries. For the estimation of oestrogen recovery, timothy grass was measured earlier and it did not contain detectable amounts of plant oestrogens. Precisely 40 g of grass was measured into the incubation bottle and handled similar to an ordinary sample.

Statistical analyses

Data of number of lambs born and the date of birth was analysed by standard two-way analysis of variance within the general linear models of SAS procedure, using a model which classified feeding group and breed of the ewe. The difference in results of plant oestrogen content between two hydrolysis methods as well as DM intakes between silages were tested by using t-test in paired two sample of means.

Results and discussion

The weather was rainy in July (precipation 107 mm during 1–16 July), but later a long drought (precipation < 10 mm during 8 August – 9 September) impaired aftermath growth, and therefore the grazing period was shorter than expected. August was warmer than normal. In Jokioinen, maximum daily temperature in August averaged +24°C.

Yield, botanical and chemical composition

DM yield of the lucerne sward harvested for silage was 7400 kg ha^{-1} at the end of June and those calculated for samples obtained from the regrowth in mid August 3760 and 2900 kg ha^{-1} for the lucerne and control swards, respectively. The proportion of lucerne in fresh yield averaged 70.5% and 88%, respectively. Crude protein content (CP) was high in both the first (199 g CP kg^{-1} DM), and second harvest (206 g CP kg^{-1} DM). Lucerne had a lower structural fibre and higher protein content, but its calculated energy was slightly lower than the control grass. Sward height varied from 40 to 65 cm at the beginning of grazing. The chemical composition and feed values of lucerne and control grass and silage are shown in Table 1. Both silages were well preserved and smelled pleasant. Butyric acid was encountered only in small amounts. Because of the more extensive lactic acid fermentation in lucerne silage, its pH value was higher than in grass silage. The lucerne silage (control silage in parenthesis) contained lactic acid 58 (32), acetic acid 42 (25), propionic acid 0.3 (0.3) and butyric acid 0.2 (0.7) g kg^{-1} DM, soluble-N 580 (551) and NH_3-N 51.5 (31.5) g kg^{-1} N, and had a pH of 4.44 (4.17).

Plant oestrogens

In timothy grass, the mean recovery of isoflavones and coumestrol after extraction and analysis (mean of nine replicates) with coefficient of variation in parenthesis were for daidzein 99.6% (4.8%), coumestrol 93.8% (3.5%), formononetin 94.0% (1.5%), and for biochanin-A 97.7% (4.7%). Coumestrol concentrations were about 12% higher (P=0.007) after hydrochloric acid hydrolysis compared to the shorter hydrolysis method. For formononetin, the results were about 8% higher (P=0.002), but no difference was observed for biochanin-A. In an earlier study (Saloniemi et al. 1993) a difference in formononetin concentrations between the two hydrolysis methods was not found.

Table 1. Mean chemical composition and feed values of regrowths of lucerne and timothy/meadow fescue pastures (14 Aug), and silages (10 Sep – 1 Dec) made from the primary growth with standard deviation.

	Yellow-flowered lucerne			Timothy/fescue		
	Pasture	Leaves	Stems	Silage	Pasture	Silage
Number of samples	5	1	1	6	1	6
Dry matter, g kg^{-1}	176 (12)	196	218	210 (5)	167	204 (10)
In dry matter, g kg^{-1}						
Organic matter (OM)	899 (4)	893	923	916 (3)	907	937 (3)
Digestible OM	633 (5)	736	526	654 (7)	690	675 (1)
Crude protein	206 (5)	310	119	192 (5)	200	159 (11)
Neutral detergent fibre	450 (12)	219	667	453 (17)	587	575 (15)
Acid detergent fibre	318 (6)	143	493	303 (15)	281	332 (13)
Hemicellulose	132 (8)	76	173	150 (11)	306	244 (14)
Cellulose	246 (4)	123	375	252 (5)	246	301 (9)
Acid detergent lignin	72 (3)	20	118	52 (9)	35	31 (5)
WSCs	47 (3)	44	46	15 (4)	86	92 (32)
Soluble N	19 (3)	23	8	17 (1)	13	14 (1)
Feed values, kg^{-1} dry matter						
ME, MJ	9.21 (0.03)	10.76	8.39	9.30 (0.04)	11.55	11.13 (0.03)
ME, FU	0.79 (0.00)	0.92	0.72	0.80 (0.00)	0.99	0.95 (0.00)
AAT, g	79 (1)	97	67	78 (0)	96	85 (1)
PBV, g	69 (4)	142	5	59 (4)	35	14 (9)

WSCs = water soluble carbohydrates, ME = metabolizable energy, FU=feed unit, AAT= amino acids absorbed in the small intestine, PBV= protein balance in rumen.

Table 2. Mean plant oestrogen contents (ppm in DM) of fresh herbage and silage made from yellow-flowered lucerne pasture. In each figure pair the upper figure is the mean and the lower the standard deviation.

	D a t e s			Coumestrol			Formononetin			Biochanin-A		
Dates	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
Grass	26 Jun	14 Aug	9 Sep	37.2	20.5	43.0	82.1	152.3	10.6	48.8	128.3	5.7
				13.8	1.6	4.7	80.4	73.5	7.9	45.5	90.7	7.9
Leaves	26 Jun	14 Aug	9 Sep	31.5	25.5	72.5	9.3	19.6	1.8	0	15.8	0
Stems	26 Jun	14 Aug	9 Sep	28.5	5.8	10.1	12.4	8.8	2.1	0	0	0
Flowers	–	–	9 Sep	–	–	4.6	–	–	6.9	–	–	0
Silage	7 Oct	4 Nov	26 Nov	26.0	39.6	43.7	258.6	470.5	386.5	230.7	398.8	312.2

26 Jun: primary growth of lucerne used for silage making, 14 Aug – 9 Sep: regrowth grazed by ewes,
10 Sep – 1 Dec: ewes fed by ensiled herbage indoors, number of samples: five for grass, one for others.

Timothy-fescue pasture grass did not contain any detectable amounts of plant oestrogens, but in the direct-cut grass silage, small amounts of formononetin (57.6 ppm) and biochanin-A (29.8 ppm) were found during the mating period (4 November). Oestrogenically effective compounds found in silage could be partially explained by the fact that these compounds were formed from oestrogenically inactive precursors as a result of fermentation during storage (Kallela 1980). Formononetin and biochanin-A contents in yellow-flowered lucerne grass and silage were also negligible (Table 2). Notably higher amounts of formononetin and biochanin-A have

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been determined in other Finnish forage legumes e.g. in red clover silage (Kallela 1974).

The main plant oestrogen found in yellow-flowered lucerne was coumestrol, which belongs to the coumestans. The coumestrol content both in lucerne grass and silage was moderate averaging 33.6 and 36.4 ppm DM, respectively. The highest amounts of coumestrol were in the first cut (18.8–59.5 ppm) silage harvested in June, and in the aftermath in September (38.4–49.4 ppm). The coumestan content in lucerne (*M. sativa*) has been reported to be influenced by many factors such as variety, location, climate, and the stage of plant maturity (Hanson et al. 1965). High amounts of coumestans have been found in association with foliar disease (Loper and Hanson 1964, Smith et al. 1979). Occurrence of plant diseases was not studied in this experiment. During the experiment, the temperature did not go below 0°C. The lowest temperature measured was +3°C at the beginning of September.

Feeding lucerne has been reported in several experiments to decrease the reproductive performance of ewes. The main effect of flushing and mating ewes on lucerne is a decrease in ovulation rate and the percentage of ewes having multiple births (Coop 1977, Scales et al. 1977, Smith et al. 1979, Ramon et al. 1993). The concentration of coumestans causing reduced fertility in ewes has also been discussed. Scales et al. (1977) reported that lucerne containing about 100 ppm coumestans depresses reproductive performance. Smith et al. (1979) found that dietary levels of coumestans as low as 25 ppm significantly depressed ovulation rate. In an experiment with Merino ewes normally having a single ovulation, only levels of 1000 ppm coumestans effectively reduced the ovulation rate (Kelly et al. 1976). Prolonged exposure (10 months) to moderate amount (25–30 ppm) of coumestans has been reported to cause alterations in the cervix and uterus of ewes (Cantero et al. 1996).

Live weights and feed intake of ewes

In August, at the beginning of grazing period the L and G ewes weighed on average 72.8 (SD 9.5) and 68.7 (SD 7.8) kg, respectively. Mean body condition scores for both groups were 3.0 (SD 0.5) which is generally recommended for mating ewes. Changes in live weights of ewes were small. On pasture G ewes increased their weight by 5.0 kg and L ewes on average by 2.5 kg. According to nutrient recommendations (Tuori et al. 1996) it was concluded that L ewes on lucerne pasture consumed at least 5.40 kg (0.95 kg DM) and received metabolizable energy 9.6 MJ and protein 75 g AAT a day. During the 4-week grazing period, L ewes received on average 19.5 mg coumestrol, 144.7 mg formononetin and 121.9 mg biochanin-A in their daily feed ration.

From the beginning of indoor feeding to the end of mating, L and G ewes consumed (g per $kgW^{0.75}$) their respective silage on average 1.77 (65) and 1.40 (53) kg DM ewe^{-1} day^{1}. Both L and G ewes satisfied their energy and protein requirements at mating. Energy and protein intakes of L ewes were 22% and 12% higher than those of G ewes, respectively. When ewes were offered both silages *ad libitum*, they preferred lucerne to grass silage (1.34 vs. 0.41 kg DM ewe^{-1} day^{-1}) (P=0.001). Earlier feeding on lucerne or grass silage had no effect on their feed choice. During a 70-day experimental indoor feeding, L ewes received in their daily feed ration 58.1 mg coumestrol, 645.3 mg formononetin and 557.1 mg biochanin-A. Ramon et al. (1993) found that a daily intake of 27 mg coumestrol caused a reduction in ovulation rate but not prolificacy.

Mating performance and lambing rates

At the beginning of mating, one ewe in the L group was lost accidentally. All ewes in both groups came in heat and were mated by a Finnish Landrace ram. Three ewes in the L group and two in the G group were remated during the following heat. The L group conceived and lambed five days earlier than the G group (P=0.03). However, the difference in lambing date between the two groups is unlikely to be of biological signif-

Table 3. Mating and lambing performance of ewes grazed lucerne and timothy/ meadow fescue pastures with standard deviation.

	Yellow-flowered lucerne	Timothy-meadow fescue
Number of ewes	16*	17
Live weight at mating, kg	86.7 (10.2)	79.8 (9.0)
Condition score at mating (max. 5)	3.8 (0.4)	3.4 (0.5)
Ewes that conceived:		
Ewes mated in cycle I, %	75.0	88.2
Ewes mated in cycle II, %	18.8	5.9
Barren ewes, %	6.2	5.9
Ewes at lambing:		
Twin births, %	40	19
Triplet births, %	20	56
Quadruplet-sextuplet, %	40	25
Prolificacy (lambs/ewe)	3.13	3.19
Birth mortality of lambs, %	0	7.8

* One ewe was accidentally lost before mating.

icance given the relatively small group size and variability of this characteristic. The proportion of ewes (one ewe per group) which did not lamb was normal for adult Finnish Landrace ewes.

Ewes fed yellow-flowered lucerne received much higher, but still only moderate amounts of plant oestrogens than control ewes. No difference in lambing performance was found between the two feeding treatments (L group: 16 ewes, 47 lambs vs. G group: 17 ewes, 51 lambs). Four G lambs were stillborn, but none of the L lambs. In addition to twins, triplets and quadruplets, also one litter of quintuplets and sextuplets were born to the L and G ewes, respectively. Only two lambs from one litter of quadruplets were lost accidentally at the age of one day.

There were no differences in litter size between L and G ewes (3.19 vs. 3.13 lambs per ewe lambing, P=0.76) (Table 3). Prolificacy in both ewe groups was high. In recorded flocks of adult Finnish Landrace ewes averages of 2.8 lambs per ewe per year occur (Savolainen 1996). The current lambing results were not consistent with Scales et al. (1977) and Smith et al. (1979), who found that ewes flushed and mated on lucerne had fewer multiple births than those flushed and mated on grass pasture. A possible explanation could be that the level of plant oestrogens in our study was not very high. Purebred Finnish Landrace ewes gave birth to more lambs than the half-bred ewes (3.56 vs. 2.62 lambs per ewe, P=0.01). Detailed, long term studies are needed to relate the rate and duration of plant oestrogen intake from lucerne with the degree of ewe infertility.

Conclusions

Yellow-flowered lucerne is a high yielding and nutritious forage plant. Ewes preferred to consume lucerne silage to grass silage. Moderate coumestrol content of lucerne (26–44 ppm in DM) had no detrimental influence on ewe conception rate or prolificacy. Plant oestrogens in yellow-flowered lucerne might rather hasten oestrous activities in ewes and thus shorten the mating period. Due to a good palatability and high protein content, yellow-flowered lucerne can also be considered suitable for feeding pregnant and lactating ewes.

Acknowledgements. The authors wish to thank the technical staff of Animal Production Research and Plant Production Research for their invaluable assistance in conducting the trial.

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SELOSTUS

Sirppimailanen astutettavien uuhien ruokinnassa

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Nurmipalkokasveihin kuuluva, sinimailasen lähisukulainen sirppimailanen (*Medicago falcata* L.) on uusi tulokas rehukasvivalikoimassamme. Sirppimailanen tuotiin maahamme Virosta 1980-luvun loppupuolella. Alkuaan kasvi on kotoisin Iranista ja Kaspianmeren alueelta. Aikaisempien tutkimusten mukaan sirppimailanen on sopeutunut hyvin maamme olosuhteisiin ja talvehtinut Etelä-Suomessa ilman merkittäviä talvituhoja. Uusista rehukasveista on tärkeää selvittää niiden sadon ja ruokinnallisen arvon lisäksi myös niiden mahdollisesti sisältämät haitta-aineet ja haitta-aineiden vaikutus eläinten terveydelle. Nurmipalkokasvien tiedetään sisältävän estrogeenisesti vaikuttavia aineita, ns. kasviestrogeeneja. Etenkin lammas on herkkä kasviestrogeenien aiheuttamille tiinehtyvyys- ja sikiävyyshäiriöille. Sirppimailasen sisältämien kasviestrogeenien mahdollista haitallista vaikutusta uuhien hedelmällisyyteen arvioitiin vertaamalla toisiinsa sirppimailas- ja timotei-nurminataruokinnalla olevien uuhien kiimaantuloa, tiinehtymistä ja karitsatuotosta.

Sirppimailanen tuotti runsaan ja valkuaispitoisen kuiva-ainesadon. Valkuaispitoisuus oli korkea sekä ensimmäisessä että toisessa sadossa. Vertailulaitumen timotei-nurminataruoho ei sisältänyt lainkaan kasviestrogeeneja, sen sijaan nurmisäilörehusta löydettiin pieniä määriä formononetiinia ja biochanin-A:ta. Myös sirppimailasruohon ja -säilörehun formononetiini- ja biochanin-A -määrät olivat vähäisiä. Sirppimailasen kumestrolipitoisuus oli korkeahko.

Sisäruokintakauden alusta astutuskauden loppuun uuhet söivät sirppimailassäilörehua (g/metabolinen elopaino-kg) keskimäärin 1,77 (65) ja nurmisäilörehua 1,40 (53) kg ka/uuhi/pv. Vapaasti molempia säilörehuja saadessaan uuhet söivät halukkaammin sirppimailas- kuin timotei-nurminatasäilörehua.

Vaikka sirppimailasella ruokitut uuhet saivat rehuannoksestaan timotei-nurminadalla ruokittuja uuhia huomattavasti suurempia kasviestrogeenimääriä, ei ruokinnalla todettu olevan vaikutusta uuhien karitsatuotokseen. Sirppimailasella ruokitut uuhet tiinehtyivät keskimäärin 5 päivää aikaisemmin kuin timotei-nurminadalla ruokitut. Sikiävyys molemmissa uuhiryhmissä oli hyvä. Pitkäaikaisen sirppimailasruokinnan vaikutus uuhien lisääntymiseen vaatii lisätutkimuksia.