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Efficiency of a set-stocking system for sheep

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SUMMARY - For three consecutive years different genotypes of ewe with lambs were transferred to the enclosed pasture of Improvement Grassland Station at Závišín (West Bohemia). They were pastured there throughout the grazing season using the set-stocking system. We studied the yields of the grassland, growth rates of lambs (age range 30 to 180 days) and changes in liveweight of ewes. Efficiency of the system was evaluated in relation to growth rates of ewes and lambs per 1 ha of grassland. Mean daily weight increments of lambs amounted to about 0.2 kg and were affected mainly by litter size. There were differences between single and twin lambs, on the one hand, and triplets, on the other. Liveweight gain of ewes on grassland were about 10 kg and were significantly affected only by their age. The total liveweight gain per 1 ha ranged from 766 to 866 kg. Low grazing of swards improved their quality.

Key words: Sheep, set-stocking system, lamb growth rate, quality of swards.

RESUME - "Efficacité d'un système de pâturage continu chez les ovins". Les brebis porteuses de différents génotypes ont été conduites avec les agneaux pendant 3 années de suitesu dans un pâturage enclos de la station-prépâturage Závišín et élevées là-bas pendant toute la période de la pâture ("set-stocking system"). On a suivi le rendement de la pâture, la croissance des agneaux et la variation du poids vif des brebis porteuses en pacage (âge des agneaux de 30 à 180 jours). On a jugé l'efficacité du système sur la base de l'accroissement des brebis porteuses et des agneaux pour 1 ha de pâturage. L'accroissement moyen journalier des agneaux faisait 0,2 kg, étant influencé par le nombre de jeunes d'une naissance. Des différences ont été relevées entre un seul jeune et les doubles d'un côté et les triples de l'autre côté. L'accroissement du poids vif des brebis porteuses était d'à peu près 10 kg; il n'y a que l'influence importante de l'âge. On a obtenu un accroissement total de 766 à 866 kg du poids vif par ha de surface. Un faible pâturage des prairies améliore leur qualité.

***Mots-clés** : Brebis, set-stocking system, croissance des agneaux, qualité de la couverture.*

Introduction

Many of the problems associated with sheep breeding in Czechoslovakia can be blamed on defects in the prevailing system of sheep farming, the carpathian system

(housing system), which has been developed under specific conditions to fulfil limited breeding aims. However, the traditional ways of sheep breeding remained even though they were costly, demanding large investment in energy and buildings. In addition they incorporated expensive methods of fodder cultivation and preservation, and a large amount of human labour. Under such systems the use of pasture was ineffective. One of the ways of raising the efficiency of sheep breeding is collective ewe and lamb pastoral farming (set-stocking).

The Macaulay Land Use Research Institute (MLURI) in Great Britain has been studying pastoral sheep farming for a long time on such topics as available sheep pasture management, establishing and cultivating pasture, pasture utilisation by sheep and breed testing on pasture and subsequent evaluation of animal performance (HFRO, 1979-81; 1984-1985). More recently, in addition to the main interest in intensifying sheep breeding in mountainous areas and increase profitability of sheep farming, the ecological aspects of pastoral sheep farming are being emphasised.

Hodgson and Maxwell (1985) interpret pasture/animal interactions as the transfer of nutrients from the soil to plants and from plants to animals. The output of animal products is determined by the joint effect of several different factors (e.g. climate, grass growth, application of nitrogen, sward height), which do not include additive relations. Thus the quality of pasture is of prime importance, while the moving of fences and animal density are of secondary importance. According to the studies of Maxwell (1982), productivity and digestibility of pasture depends on environmental conditions, grass composition, use of fertilizers, and the organisation of grazing. Maxwell (1984) and Maxwell and Sibbald (1985) suggests 3.5-4.5 cm as the optimal height of pasture for grazing ewes and lambs. Lambs from ewes on pasture had better growth capacity than their counterparts mothered by ewes fed on hay and concentrate feeds.

Results of a study of pastoral sheep farming in mountainous areas, which consider the influence of management, breed type, degree of fertilisation, animal density and ewe to lamb ratio were presented by Sibbald (1987). Cheviot and Beulah ewes were mated with Suffolk rams on two experimental farms and their performance observed.

Success in fattening lambs on pasture is determined by the maternal ability of ewes. Genetical and non-genetical factors influencing this ability were analyzed by Křížek *et al.* (1983). During a 6 week long lactation period mothers of twins produced 38% more milk than mothers with single offspring. Ewes which had triplets produced 52% more milk than ewes with single offspring. After lactation all three genotypes showed worsening of overall body condition with the youngest ewes suffering the most (2 to 3 years of age).

A detailed study of the factors influencing lamb growth from birth till 120 days of age, under traditional raising systems, was made by Jakubec *et al.* (1974) and Křížek *et al.* (1979, 1981, 1982, 1985) among Czech sheep breeds (Merino, Cigaja, Improved Wallachian, and their crossbreds with other fertile and meat type breeds). In all cases litter size and sex turned out to be the determining factors of lamb growth. Sire genotype affected live weight of lambs at birth. However, its role in influencing live weights on the 60th and 120th day of age was limited.

Influence of the maternal genotype was of significance only up to the 2nd month of age. The age factor was effectual only in cases where younger ewes (1 year old) were compared with older ewes.

However, before implementing a set-stocking system, it was necessary to make several studies to determine the suitability of different breeds, and the possibilities of weaning lambs from different types of lambing (single, twins, triplets). The aim of the experiment was to evaluate the efficiency of the set-stocking system in Czechoslovakia.

Materials and methods

This experiment was carried out on a State farm, Velké Dvorce, in West Bohemia. The initial flock consisted of five maternal genotypes: Merino (M), Improved Wallachian (IW), Tsigaja (Ts), crossbred of Romanov ewes and M, F_1 gen. (RxM), and B1 (MxRM). Ewes were mated in November with rams of the Meat Merino (MM), Suffolk (Sf), German Long-Wool Merino (GL), Romanov (R) breeds. For the winter month the flock was kept on deep litter in a sheep house. Lambing took place throughout the month of April, and after the necessary health treatments animals were turned out onto fenced pastures. For three consecutive years between 1988 and 1990 we separated a number of the ewes with lambs from the original herd and transferred them to the Improvement Grassland Station at Závišín, near Mariánské Lázně, West Bohemia. In 1988 lambs with a mean age of 60 days an liveweight of approximately 17 kg, in 1989 and 1990 lambs with a mean age of 30 days when they weighted 10 kg in 1989 or 8 kg in 1990 respectively.

Sheep grazing in Závišín was undertaken on securely enclosed pastures at 730 to 750 metres above sea level in the Western part of the ČSFR with long term rainfall and annual temperatures averaging 702 mm and 6.4°C respectively. The pastures are on brown earth of median consistency of sand-loam with soil acidity 5.0 pH/KCl. The soils have average phosphate levels, a good supply of magnesium and high levels of potassium. The pastures predominant species of vegetation are *Lolium perenne* L., *Poa pratensis* L. and *Trifolium repens* L. The overall character of the experimental location is typical of the upland region of ČSFR.

The grass/clover swards were established at the beginning of the 1970s. Until 1984 the swards were cut and used for hayor silage. Since 1985 they have been alternately used for grazing cattle and sheep. To enable of their botanical composition, height and production of organic matter grazing enclosed cages of 5 square metres were created. The botanical composition of the pasture was determined from individual cuttings.

Under the grazing management system used, the target sward height for grazing ranged from 4 to 6 cm, with a set-stocking. Sward height was determined according to the experimental results and recommendations of Hodgson *et al.* (1986), Frame (1986), Rais (1990) and others.

The lambs were weighted at 30-day intervals until completion of supplementary

feeding (at about 180 days of age) and from the data the mean daily weight gain was calculated. The data was then analyzed using the Least Square Method (LSM) (Harvey, 1975), taking into account the effect of maternal and paternal genotypes, age of mother, litter size and sex of lambs. In 1989 liveweight of ewes was also recorded at the beginning and at the end of the grazing period, and changes in their weight during this period were calculated. The data obtained was then analyzed using the LSM method in relation to the genotype and age of mother and litter size. In 1990 we examined the effect of supplementary feeds administered to ewes on growth of their lambs. Since 28th April (the day of transfer to pasture) the experimental group received a grain mixture ratio of 0.2 kg per head per day. Between 3rd and 31st July administration of concentrate was interrupted for technical reasons and resumed on 1st August with elevated rations of 0.5 kg per head per day. The control group received no supplementary feeds.

Results and discussion

Analysis of variance demonstrated that in 1988 the live weight of lambs between 60 and 180 days of age had been influenced by the genotype of father and the sex of the lambs. The genotype of mother and litter size did not affect their growth (Table 1). Changes in liveweight of lambs on pasture appear in Table 2. Mean values show the weight of lambs has increased by 22 kg after 120 days at pasture which represents a daily weight gain averaging 0.183 kg. At age 60 days lambs from Ts and IW have exhibited the highest liveweight, with lambs of M and F ewes about 3 kg lighter. This difference persisted throughout the period of pasture fattening, but the differences between ewe genotypes gradually decreased. As to paternal genotypes, lambs sired by Sf rams proved to be distinctly better and they manifested a 5 kg increase in live weight at 180 day of age in comparison with other lambs. By the age of 120 days there were no significant differences between genotypes GL and R. Approximately the same differences were observed between male and female lambs when males was 3.9 kg heavier than females on completion of feeding.

Table 1. Significance level of effects for live weight of lambs on the pasture in 1988 (F-values)

Effect	Live weight at (days)				
	60	90	120	150	180
Ram genotype	4.15^{+}	4.76^{++}	3.65^{+}	5.06^{++}	4.62^{+}
Ewe genotype	2.46^{n}	1.86^{n}	0.39^{n}	0.65^{n}	0.52^{n}
Litter size	2.74^{n}	2.90^{n}	2.59^{n}	2.16^{n}	1.88^{n}
Sex	8.92^{++}	15.85^{++}	16.46^{++}	20.61^{++}	15.02^{++}

$^{+}$ $P \leq 0.05$, $^{++}$ $P \leq 0.01$, n = N. Signif.

The rate of growth of lambs is shown in Fig. 1. It can be seen that the highest weight gains were achieved at around 60 days of age; with a marked decrease in growth rates occurring at 120 days of age. Thereafter growth rates increased again. The reason for this decrease was a summer drought-related reduction in green feed. The ewes produce less milk during this period, while lambs are unable to consume enough feed to compensate for the loss of energy caused by reduced milk intake.

Table 2. Live weight of lambs on the pasture in 1988 (LS means,standard errors and estimate of average)

Classification	n	Live weight of lambs (kg) at age (days)				
		60	90	120	150	180
Mean value	87	16.80	23.96	28.50	34.60	38.80
Stand. error		0.501	0.654	0.854	0.930	0.951
Litter size						
Single	9	17.55	24.97	29.74	35.84	39.90
Twins	78	16.05	22.95	27.26	33.37	37.62
Sex						
Male	50	17.59	25.33	30 33	36.83	40.75
Female	37	16.01	22.59	26.68	32.38	36.86
Ewe genotype						
M	22	15.30	22.35	27.77	34.33	37.68
IW	19	18.17	25.77	29.73	36.05	40.36
Ts	14	18.62	25.73	28.81	34.07	39.65
F_1 (RxM)	32	15.10	21.99	27.70	33.96	37.52

M (Merino), IW (Improved Wallachien), Ts (Tsigaja), F1 (Romanov x Merino)

Growth rate of lambs in 1989 was significantly affected only by litter size with this effect on growth manifesting itself only at age from 90 to 150 days (Table 3). Comparison of the mean values of growth rate (Table 4) with data obtained in 1988 shows that in 1989 lambs exhibited higher growth rates up to the age of 120 days. Thereafter their growth rates rapidly decreased, their weight at 180 days of age being 1.5 kg lower than in the preceding year. The decrease was caused not only by grass

reduction on grasslands but mainly by infestation of the herd with endoparasites. As soon as the cause was diagnosed and antihelmintic therapy started, growth rates increased (Fig. 2).Daily weight gain between 30 and 120 days of age averaged 0.246 kg which confirms the high efficiency of the set-stocking system. Triplets which are considered unproductive under the conventional system showed also very satisfactory growth rates.

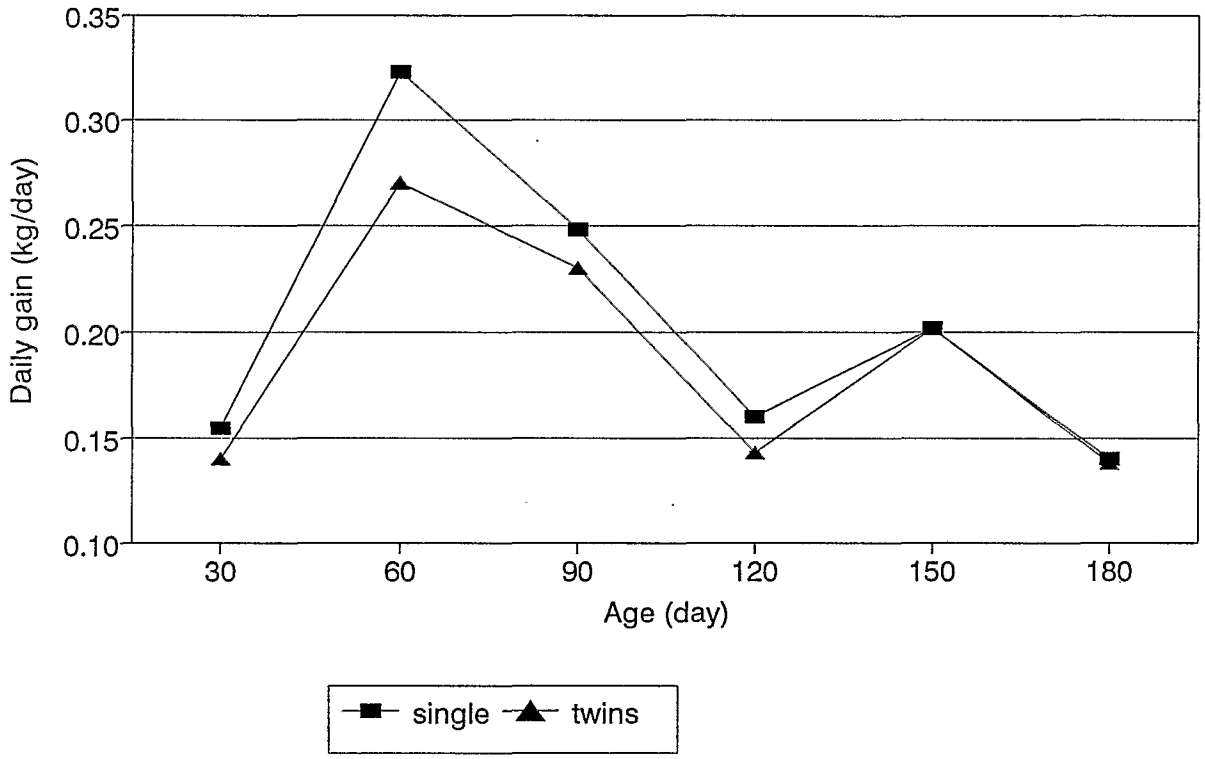

Fig. 1. Growth rate of lambs on the pasture (1988).

In 1989 the weight of ewes was recorded at the beginning and at the end of grazing period (Table 5). An increase in liveweight of over 10 kg was observed in all instances. The differences in the weight of ewes were analyzed in relation to the genotype and age of the ewe and the litter size. Only maternal age was found to have a statistically significant effect. Of the genotypes studied of mothers the highest weight gain were found among Ts and IW ewes. Ewes with single lambs and twin lambs showed gains 2 kg higher in comparison with ewes with triplets and quadruplets. Ewes of lower age groups had higher weight gain than older ewes.

In 1990 we studied the effect of supplementary feeds on growth rates of lambs on grassland. Changes in liveweight and growth rates of lambs from birth up to 180 days of age were analyzed in relation to supplementary feeding, litter size and sex of lambs. During supplementary feeding period the liveweight of lambs was affected by litter size from birth until 90 days of age; while sex affected their growth rate on day 60 (Tables

6 and 7). Supplementary feeding of ewes had no significant effect on the liveweight of the lambs. Average daily weight gain was affected by the same factors. The effect of supplementary feeding of ewes manifested itself in lambs only between 90 and 150 days of age.

Table 3. Significance level of effects for live weight of lambs on the pasture in 1989 (F-values)

Effect (n=88)	Live weight at (days)						
	Birth	30	60	90	120	150	180
Lamb genotype	0.19^{n}	0.79^{n}	0.20^{n}	0.21^{n}	0.054^{n}	0.003^{++}	0.05^{+}
Ewe genotype	1.58^{n}	1.10^{n}	1.16^{n}	1.67^{n}	1.44^{n}	2.33^{n}	1.09^{n}
Ewe's age	1.24^{n}	0.97^{n}	1.07^{n}	0.78^{n}	0.77^{n}	0.48^{n}	0.57^{n}
Litter size	26.48^{++}	22.59^{++}	11.81^{++}	11.77^{++}	10.23^{++}	10.09^{++}	5.16^{++}
Sex	0.19^{n}	2.84^{n}	1.02^{n}	6.47^{+}	4.77^{+}	4.58^{+}	3.72^{n}

$^{+}$ $P \leq 0.05$, $^{++}$ $P \leq 0.01$, n = N. Signif.

From being put out to pasture up to 150 days of age lambs displayed an even and high rate of growth (Tables 8 and 9, Fig. 3). Average daily gains exceeded 0.2 kg and slaughter weight rose to 35 kg. From 30 to 90 days of age higher weight gains were recorded for the group receiving no supplementary feeds (control); with this difference averaging 0.025 kg per day. From age 100 to 130 days neither group of lambs received supplementary feeds. From 130 days of age the experimental group received a higher ration of concentrate feeds (0.5 kg per head per day) which manifested itself as a higher growth rate of 0.032 kg per day.

During the grazing at Závišín meat production gains per ha were also compared and the results are listed in Table 10. As illustrated in this table, nutrient conversion seems to have been highest in ewes with lambs. Ewes and lambs showed the highest liveweight gains per ha despite receiving no supplementary feeding. Cattle received minor concentrate supplement.

Sward productivity can be classified as satisfactory. Data on the swards over the past four years are given in Table 11. During the period under review an attempt was made to reduce the nitrogen content and increase the content of white clover.

During this period we failed to achieve the target white clover content of 20 to 30%. In our opinion, this was accounted for primarily by low productivity of local white clover strains. Table 12 shows the mean values of sward nutrients (annual means and yields). Grazing management is an essential factor affecting sward productivity, organic matter production and herbage growth rate during the period of vegetative

growth. Sward productivity and its growth rate is affected primarily by the range of species (of the swards), climatic conditions and the amount of nitrogen fertilisers.

Table 4. Live weight of lambs on the pasture in 1989 (LS means, standard errors and estimates of average

Classification	n	Live weight of lambs (kg) at age (days)					
		30	60	90	120	150	180
Mean value	88	9.89	18.75	26.25	32.38	33.71	37.31
Standard error		0.420	0.691	0.882	1.041	1.004	1.084
Litter size							
Single	11	12.75	22.15	30.62	37.19	38.31	40.49
Twins	42	9.02	17.69	24.41	30.36	32.04	37.13
Triplets	35	7.91	16.42	23.72	29.58	30.79	34.32
Sex							
Male	51	10.26	19.12	27.42	33.57	34.84	38.41
Female	37	9.52	18.39	25.07	31.19	32.59	36.22
Ewe genotype							
M	35	9.58	18.25	24.97	30.55	32.66	36.56
IW	9	9.86	18.68	26.69	33.65	34.73	39.24
Ts	8	11.19	21.21	30.06	36.40	39.08	41.05
F_1 (RxM)	28	10.11	18.66	25.55	31.23	33.16	37.05
B_1 (MxRM)	8	8.71	16.99	23.97	31.05	28.94	32.66

Fig. 4 depicts the rate of herbage production when applying 200 kg nitrogen per ha in four equal parts doses from the end of April till mid-August. The straight line in the figure represents the herbage requirements for a stocking rate of about 1700 kg liveweight per ha at the end of the grazing period. The line represents the herbage grazed by the animals, losses caused by overfertilisation by sheep faeces, cutting of ungrazing land strips and trampling. Grass within enclosed cages was cut at 6 cm 12 to 14 times during pasture.

Although this depicts the situation in 1990 conditions, a comparable graph shows be seen for any year. The beginning of May is marked by a dramatic growth which is brought to a halt by the dry spell which is very common towards the end of May. A further peak of production is seen in July only to be slowed down again by drought. The autumn course of growth varies year by year; 1990 was atypical owing to its

relatively high rate of growth of organic matter extending until September.

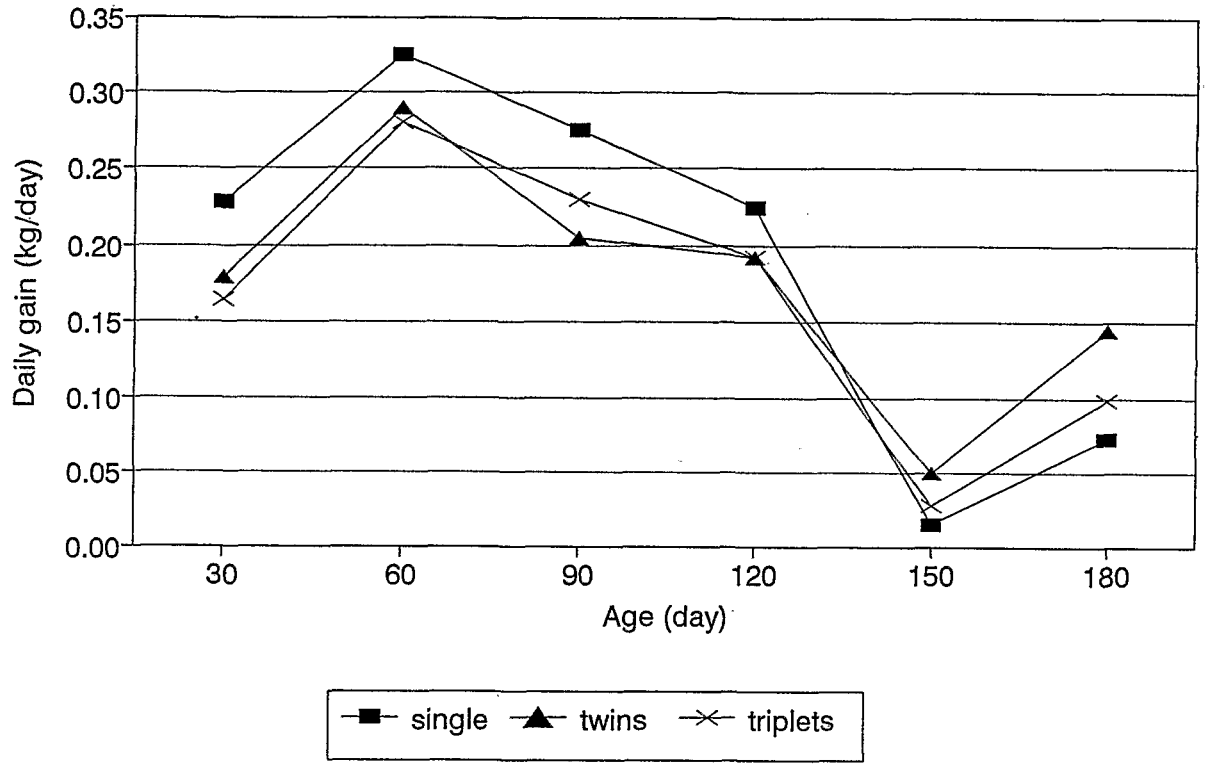

Fig. 2. Growth rate of lambs on the pasture (1989)

The organic matter growth rate/food requirements ratio as shown by the Fig. 4. might support the assumption of an incorrectly assessed stocking rate. Yet in fact the excess of grass in spring time was not cut and conserved but eliminated only by cutting ungrazed areas (land strips). The excess of grass in June was carried over to July by allowing grazing of swards higher then 6 cm.

Interestingly, the size of areas closed in the spring for cutting and conservation were higher when grazed by cattle then by sheep. Using set-stocking and appropriate stocking rate, sheep usually manage to graze all grass and there is no need to cut and conserve part of it. This is due to different requirements of the two animal species. Ewes which are lambing towards the end of March and beginning of April, reach pastures by the end of April when swards are about 2 cm high. Ewes start grazing the sward immediately and slow down its growth. At the peak of sward growth lambs also begin to consume solid food and the stocking rate during the grazing season roughly doubles. In experiments carried out at Závišín we stocked 1 ha with 14 to 16 ewes with lambs, the lamb/ewe ratio being 1.8 (ca 1700 kg per ha).

Table 5. Live weight changes of ewe under pasture in 1989 (LS means, F-values, standard errors and estimates of average)

Classification	n	Live weight changes
Mean value	88	10.19^{+}
Stand. error		1.149
Ewe genotype		
F value		1.61^{n}
M	35	8.51^{+}
IW	9	12.29^{+}
Ts	8	15.14^{+}
F_1 (RxM)	28	7.57^{+}
B_1 (MxRM)	8	7.45^{+}
Ewe's age		
F-value		2.54^{+}
2	10	12.28^{+}
3	5	14.75^{+}
4	8	13.58^{+}
5	24	8.34^{+}
6	18	10.73^{+}
7	23	7.98^{+}
Litter size		
F-value		1.63^{n}
Single	11	10.52^{+}
Twins	42	11.53^{+}
Triplets	35	8.53^{+}

$^{+}$ $P \leq 0.05$, n = N. Signif.

Sheep with lambs grazed the swards fairly evenly and we observed no selective grazing of some species. However, with the start of seed heading and progressive increase in senescence of grass with its height exceeding 10 cm, the animals stopped grazing. In order to maintain the target sward height, we cut and conserved the grass or tipped rests of organic matter. In this way sward height was kept uniform. Over a period of two to three years low grazing of swards had a distinct effect on their

composition from which *Taraxacum oficinale* Web. off and *Dactylis glomerata* L. declined.

Table 6. Significance levels for live weight of lambs from birth up to days of age (F-values)

Effect	n	Age of lambs (days)					
		Birth	30	60	90	150	180
Litter size	62	3.86^{+}	9.44^{++}	5.19^{++}	5.45^{++}	2.86^{n}	2.39^{n}
Sex	62	0.32^{n}	3.39^{n}	7.56^{++}	14.13^{++}	14.30^{++}	22.03^{++}
Concentrates	62	2.03^{n}	6.05^{+}	0.04^{n}	0.80^{n}	0.11^{n}	0.46^{n}

$^{+}$ $P \leq 0.05$, $^{++}$ $P \leq 0.01$, n = N. Signif.

Table 7. Significance levels for daily weight gain of lambs from birth up to 180 days of age (F-values)

Effect	n	Age of lambs (days)				
		30	60	90	150	180
Litter size	62	6.93^{++}	0.37^{n}	5.28^{++}	0.12^{n}	0.21^{n}
Sex	62	2.76^{n}	13.71^{++}	10.87^{++}	5.95^{+}	0.55^{n}
Concentrates	62	9.89^{++}	1.94^{n}	4.04^{+}	5.29^{+}	0.25^{n}

$^{+}$ $P \leq 0.05$, $^{++}$ $P \leq 0.01$, n = N. Signif.

From the point of view of animal nutrition, the amount of potassium was somewhat high, this can be attributed to grazing very young swards. Even discontinuing the use of potassium for a period of five years failed to change its level. Sheep received no concentrates when grazing. Lambs in our experiment were fed on maternal milk and fodder. In the traditional breeding system feed consisted of fodder silage and concentrates. Lambs had always a free access to maternal milk. This type of fattening is labelled as intensive. If we compare our results for the whole fattening period (150 days), with those of Jakubec *et al.* (1974), Křížek *et al.* (1982, 1983, 1985), we find out that pasture fattening of sheep has equal or higher average daily gains in weight in comparison to the traditional systems.

Table 8. Live weight of lambs form birth up to 180 days of age in 1990 (LS means, standard errors and estimates of average)

Classification	n	Live weight of lambs (kg) at age (days)					
		Birth	30	60	90	150	180
Mean value	62	3.55	7.87	15.65	22.67	35.24	36.45
Stand. error		0.159	0.315	0.547	0.668	0.963	0.833
Litter size							
Single	7	4.24	9.90	18.37	25.89	38.66	39.05
Twins	49	3.50	6.94	14.70	21.09	33.62	35.02
Triplets	6	2.92	6.78	13.86	21.03	33.44	35.26
Sex							
Male	32	3.61	8.26	16.66	24.36	37.79	39.18
Female	30	3.49	7.49	14.64	20.99	32.69	33.71
Concentrates							
No	29	3.71	7.33	15.72	23.09	35.01	36.04
Yes	33	3.39	8.41	15.57	22.26	35.48	36.86

Table 9. Daily weight gain of lambs under pasture in 1990 (LS means, standard errors and estimates of average)

Classifi-cation	n	Growth intensity of lambs (kg) at age (days)				
		30	60	90	150	180
Mean value	62	0.142	0.262	0.223	0.203	0.018
Stand. error		0.009	0.009	0.008	0.009	0.001
Litter size						
Single	7	0.191	0.275	0.244	0.207	0.017
Twins	49	0.114	0.258	0.193	0.206	0.019
Triplets	6	0.121	0.254	0.233	0.195	0.019
Sex						
Male	32	0.153	0.286	0.242	0.219	0.019
Female	30	0.132	0.238	0.204	0.187	0.017
Concentrates						
No	29	0.122	0.272	0.235	0.187	0.019
Yes	33	0.163	0.253	0.211	0.219	0.018

Table 10. Production gains per 1 ha of sward for various categories of animals

	Live weight gains in kg per ha at Závišín		
	Year 1988	Year 1989	Year 1990
Heifers	430	365	448
Steer (year 1)	645	554	747
Steer (year 2)	x	575	514
Cows with calves	x	575	417
Ewes with lambs	861	866	766

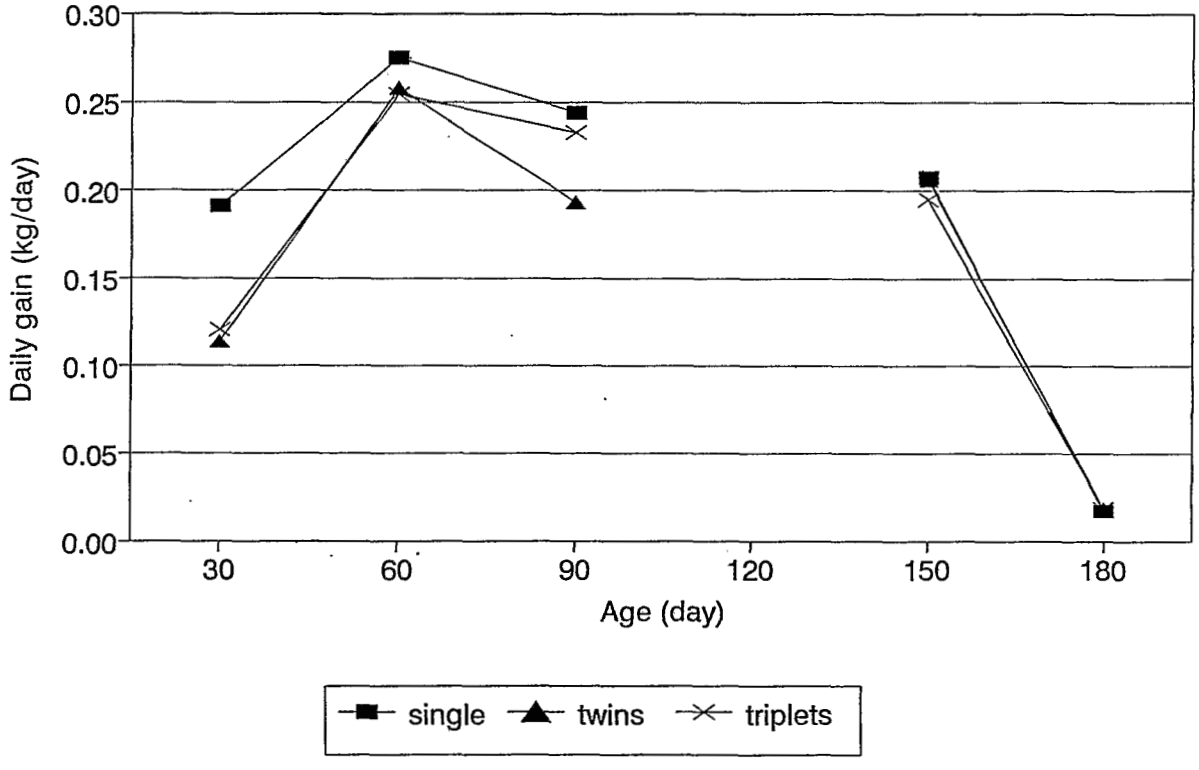

Fig. 3. Growth rate of lambs on the pasture (1990).

From the estimated averages of growth it is possible to conclude that all tested genotypes are fit for pasture breeding, and that this system of sheep breeding is a suitable alternative for sheep breeding in Czechoslovakia.

Table 11. Data on the sward at Závišín

	Year			
	1988	1989	1990	1991
kg N ha^{-1}	200	200	100	0
Herbage yields (t/ha)	44.0	53.6	50.4	30.3
withe clover/weight %	12	16	8	12

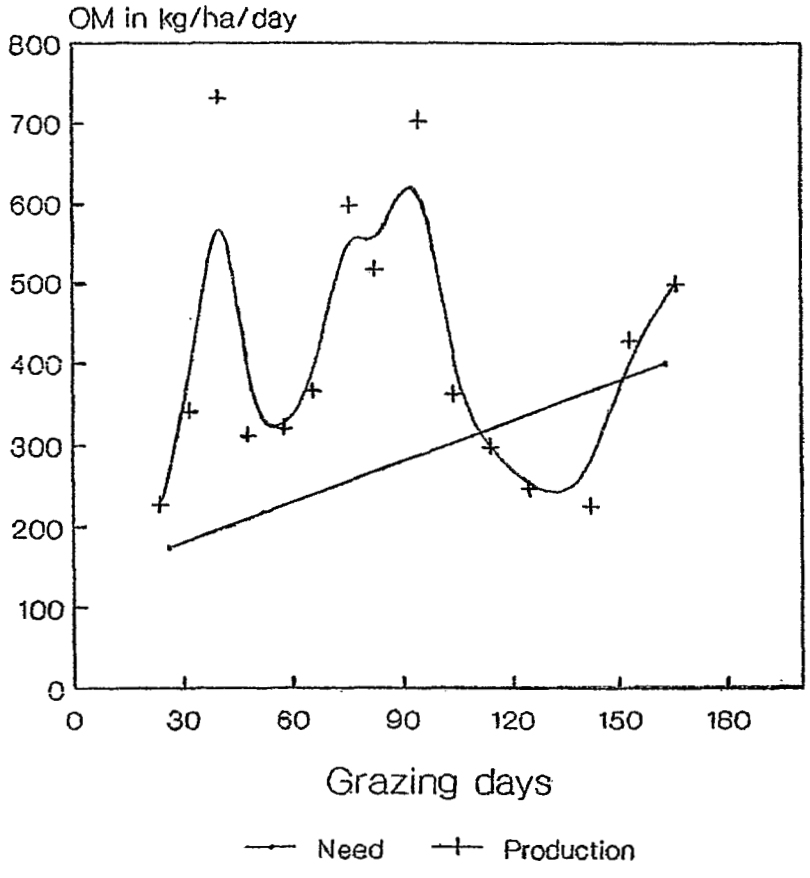

Fig. 4. Forage production on sheep pasture (set stocking), Zavisin 1990. Fertilized by 200 kg N ha^{-1}.

Table 12. Nutrient contents in % of dry matter at Závišín

	Set stocking No.		
	2	3	4
N	3.58	3.56	3.60
P	0.43	0.44	0.34
K	3.23	3.20	2.47
Ca	0.46	0.51	0.40
Mg	0.15	0.15	0.17

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