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Some reproductive and growth traits of crossbred genotypes produced by crossing local sheep breeds of Kivircik x White Karaman and Chios x White Karaman in steppe conditions

Abstract

The aim of this study was to investigate some production traits of crossbred genotypes produced for lamb production by crossing local sheep breeds of Kivircik (K) x White Karaman (W) and Chios (C) x White Karaman in steppe conditions. W breed is raised in steppe conditions while K and C breeds are raised in Mediterranean climate conditions in Turkey. A total of 340 ewes was used through 3 years. The litter size for W, KWF_1 and CWF_1 ewes were 1.26, 1.19 and 1.52 ($P<0.05$), respectively. The least squares means of W, KW F_2, KW B_1, CW F_2 and CW B_1 lambs were 91.2, 95.7, 95.6, 87.3 and 94.2 % for survival rate at weaning (90 days); 4.4, 4.3, 4.1, 4.2 and 4.1 kg for birth weight; 21.1, 20.3, 19.6, 20.3 and 19.9 kg for weaning weight; 31.9, 29.4, 30.3, 30.5 and 30.1 kg for 180 day weight, respectively. The differences among genotypes for survival rates and growth performance of lambs were not statistically significant ($P>0.05$). The results indicated that Chios crossbred ewes had the highest reproductive performance while all genotypes had similar performance in terms of survival and growth of lambs in steppe conditions.

Key Words: sheep, steppe conditions, breed crossing, reproductive traits, survival rate, live weight

Zusammenfassung

Titel der Arbeit: **Ausgewählte Reproduktions- und Wachstumsmerkmale von Rassenkreuzungen der Schafrassen Chios x White Karaman und Kivircik x White Karaman unter Steppenbedingungen**

Es wurden Leistungen von Kreuzungstieren aus den Rassen Chios (C), White Karaman (W) und Kivircik (K), die unter Steppenbedingungen gehalten wurden, untersucht. Das Verbreitungsgebiet der an die mediteranen Bedingungen der Türkei angepassten Rassen White Karaman liegt in Mittelanatolien, das der Rassen Chios und Kivircik in Westanatolien. In den dreijährigen Versuch wurden 340 Tiere einbezogen. Folgende Populationen und Versuchsgruppen wurden geprüft: White Karaman (W) (1), Kivircik x White Karaman (KW) (2), Chios x White Karaman (CW) (3), W (4), KW x KW (5), Kx KW (6), CW x CW (7), C x CW (8). Bei der Zahl der Lämmer je Ablammung erreichten die Gruppen 1-3 jeweils 1,26; 1,19 und 1,52 Tiere. Das Geburtsgewicht der Lämmer aus den Gruppen 4-8 lag bei 4,4; 4,3; 4,1; 4,2 und 4,1 kg. Der Anteil der am 90. Tag lebenden Lämmer betrug für die Gruppen 4-8: 91,2; 95,7; 95,6; 87,3 und 94,2 % mit einem Durchschnittsgewicht von: 21,1; 20,3; 19,6; 20,3 und 19,9 kg. Am 180. Tag erreichten die Tiere der Gruppen 4-8 ein Durchschnittsgewicht von 31,9; 29,4; 30,3; 30,5 und 30,1 kg. Zwischen den Genotypen wurden hinsichtlich der Überlebensrate und Lebendgewicht keine signifikanten Unterschiede festgestellt ($P>0,05$). Die besten Reproduktionsleistungen erreichten die Chios Kreuzungstiere unter den beschriebenen Bedingungen.

Schlüsselwörter: Schaf, Steppenbedingungen, Rassenkreuzung, Fortpflanzungsmerkmale, Überlebensrate, Lebendgewicht

Introduction

The meat production per capita in Turkey is lower than that in European Union Countries. One of the ways for increasing meat production is to improve reproductive and fattening performance of local sheep breeds.

In a terminal – sire crossbreeding, ewes of a local breed are usually mated to rams of a more prolific breed to produce crossbred ewes, which are subsequently mated to a

terminal sire (GALLIVAN et al., 1993). It is very important to produce crossbred types for lamb production for Turkey.

There are many sheep breeds in the country. They are generally multipurpose breeds which have low production levels. But some breeds such as Chios, Kivircik are better than others in terms of some production traits.

It was reported that Chios breeds of Greece and Turkey were probably the same breed. The Kivircik breed appears to have developed from Tsigai breed of Southeast Europe (MASON, 1967). Chios breed, semi-fat tailed, and Kivircik, thin-fat tailed, are noted for having higher production levels than others. Chios and Kivircik breeds are raised in the western coastal and northern – western regions of the country. Chios is well known for high milk yield, early sexual maturity and outstanding prolificacy, while Kıvırcık is noted for fattening performance and meat quality. They are poorly adapted in other parts of the country. So production levels of these breeds in inland regions, that is steppe conditions, have been sharply reduced (AKCAPINAR et al., 2000).

White Karaman breed, fat tailed, is distributed throughout Central Anatolia which is the largest region of Turkey. This breed has the largest population among the sheep breeds of the country. It has well adopted in steppe conditions. However it has low production levels (AKCAPINAR et al., 2000).

The Mediterranean climates conditions dominate in the coastal regions of Turkey while the inland greatly arid or semi-arid. Summer is hot and dry, winter cold, and spring short but wet in Central Anatolia. The majority of the region consists of treeless steppe, with an average altitude of about 900 m. Annual precipitation averages around 400 mm and decreases towards the interior to less than 300 mm. Average temperatures are 21-23 C during the hottest month and 0-(-3) C during the coldest month.

The Chios breed as an improver has been used for getting new prolific types. For this purpose, the breed was crossed with some local breeds (AKCAPINAR et al., 2000; OZCAN et al., 2001; HASSAN et al, 2002; UNAL et al., 2002b). It was reported that the crossbreds between Chios and local breeds had generally higher reproductive performance and milk yield (OZCAN et al., 2001; UNAL et al., 2002a; UNAL et al., 2002b).

The aim of this study was to evaluate some production traits of crossbred sheep genotypes of Kivircik x White Karaman and Chios x White Karaman in steppe conditions.

Materials and Methods

The study was conducted at the Lalahan Livestock Research Institute in Ankara in Central Anatolian region of Turkey, where a steppe climate prevails. The geographical coordinates for the area are 33 N and 40 E.

The crossbreeding study was started in Ulaş State Farm, in Sivas, in 1995 (AKCAPINAR et al., 2000). The ewes of White Karaman (W), Kivircik x White Karaman F_1 (KWF_1) and Chios x White Karaman F_1 (CWF_1) and the rams of W, KWF_1 and CWF_1 were obtained from this state farm in 1998. Both Research Institute and State Farm are located in similar region and have same climate conditions. Kivircik (K) rams from Inanlı Sate farm, in Marmara region, and Chios (C) rams from private breeders in Aegean region were also obtained. All rams were examined for their spermatological traits before mating season. A total of 13 rams were mated 340 ewes through 3 years. The numbers of ewes joined and lambs born by mating types

and year subclasses are shown in Table 1. KWF_1 ewes were mated with only K rams in 1998 because of having low number of ewes. The number of ewes exposed to pure rams was greater than the number of ewes exposed to crossbred rams in 2000.

Table 1
Number of ewes joined and lambs born by mating type and year subclasses (Ausgangstiermaterial nach Genotypen und Jahren)

Mating types[a]	Lamb genotype	1998 - 1999		1999 - 2000		2000 - 2001		Marginal totals	
		Ewes	Lambs	Ewes	Lambs	Ewes	Lambs	Ewes	Lambs
W x W	W	18	12	15	15	16	19	49	46
KW F_1 x KW F_1	KW F_2	-	-	21	14	15	14	36	28
K x KW F_1	KW B_1	15	11	21	18	32	32	68	61
CW F_1 x CW F_1	CW F_2	16	11	39	29	34	34	89	74
C x CW F_1	CW B_1	15	12	39	35	44	48	98	95
Marginal totals		64	46	135	111	141	147	340	304

[a] Sires are listed first

Ewes were managed together as a single group. During the 7 week mating season from October 1 to November 15 in all years, oestrus detection was performed daily by using teaser rams. The ewes were mated with their determined rams. Ewes were given a 500 g of concentrate feed per ewe daily, beginning 3 week before the mating season. The ewes were kept indoors during the winter and were on pasture in daytime during the other seasons. A 700 g of concentrate feed per ewe daily were given during six weeks before lambing. Concentrate feed per ewe daily was increased to 800 g during the lactation period. The concentrate feed included 65 % of Barley, 12.5 % of Wheat Bran, 20 % of Sunflower Meal, 1.5 % of Limestone, 0.5 % of Salt and 0.5 % of Vitamins-Minerals Premix.

Lambing took place in March and April. Lambing occurred in a building with littered floor which had ambient temperature. Routine lamb management such as clipping and iodine treatment of the navel, injection of Vitamin E – Selenium, ear tagging was practised. The lambs were remained with their dams in individual boxes for three days after birth. Then a flock of suckling lambs and a flock of their dams were formed. The lambs were allowed to suckle their mothers twice a day and received alfalfa hay and lamb grower feed. The lambs were weaned about 90 days of age.

Traits evaluated were oestrus rate and lambing rate and litter size of ewes, and survival rates and growth of the lambs. Postweaning traits of the lambs were recorded only on female lambs, because the male lambs were evaluated for fattening and carcass traits after weaning.

The rates of oestrus and lambing were recorded on ewes present at the start of lambing. The records of 2 heads of ewes died between mating and lambing, were excluded. The lambs dead at births were included for the trait of litter size, but were excluded for birth weight. The survival rates of the lambs at 1 and 3 and 6 months of ages were based on lambs born alive.

The birth weight of the lambs were measured within 12 hours of birth with a scale sensitive to 50 g. The body weights and body measurements (wither height, body length, chest girth, cannon bone circumference, the widest circumference of the tail) were recorded monthly until the lambs were 6 months of age. The absolute data of weights and measurements of body at 90^{th} and 180^{th} days were calculated by the interpolation method.

Data were analysed using least squares mixed model procedures of SPSS (ANONYMOUS, 1993). The model for traits measured on ewes was included fixed

effects of genotype (W, KWF_1, CWF_1), year (1998-1999, 1999-2000, 2000-2001) and age of ewe at mating (18, 36, 48 months of age). The traits measured on lambs were analysed by fitting effects of genotype (W, KWF_2, KWB_1, CWF_2, CWB_1), age of dam at birth (2, 3, 4 years of age), year (1999, 2000, 2001), sex of lamb (male, female) and type of birth (single, twin). The birth weights of lambs as a covariate was included the models for 3 and 6 months weights of lambs. Effect of sex could not be fitted for postweaning traits because of recording only on female lambs in the postweaning period. The statistical significances between the subgroups were determined with Duncan's Multiple Test.

Results

Reproductive traits

The least squares means for reproductive traits of W, KWF_1 and CWF_1 ewes are presented in Table 2. The differences in oestrus rate and lambing rate among year and age of ewe weren't statistically significant. The effects of ewe genotype on oestrus rate, lambing rate and litter size were significant ($P<0.05$).

Table 2
The least squares means (± SE) of some reproductive traits of ewes (Mittelwerte untersuchter Fortpflanzungsmerkmale)

Item	Oestrus rate (%)	Lambing rate (%)	Litter size
Ewe genotype	*	*	*
W	90.8 ± 4.14^{ab}	79.8 ± 6.15^{a}	1.26 ± 0.07^{ab}
KWF_1	87.9 ± 3.29^{a}	84.0 ± 4.01^{ab}	1.19 ± 0.06^{a}
CWF_1	94.2 ± 2.70^{b}	87.5 ± 4.89^{b}	1.52 ± 0.04^{b}
Year	ns	ns	ns
1998-1999	89.8 ± 4.51	82.6 ± 5.30	1.20 ± 0.09
1999-2000	87.9 ± 3.12	81.1 ± 4.93	1.25 ± 0.05
2000-2001	95.1 ± 2.66	87.6 ± 3.16	1.36 ± 0.05
Age of ewe at mating (months)	ns	ns	*
18	86.0 ± 2.47	79.5 ± 3.47	1.13 ± 0.05^{a}
36	91.7 ± 3.09	83.2 ± 4.60	1.31 ± 0.05^{b}
48	95.2 ± 4.99	88.6 ± 5.12	1.37 ± 0.08^{b}
Total	91.0 ± 2.22	83.8 ± 3.30	1.27 ± 0.04

ns non significant; * $P<0.05$; $^{a, b}$ Means within a column in a subgroup with different superscripts differ significantly ($P<0.05$).

Survival of lambs

The least squares means for the survival rates of live born lambs are given in Table 3. There were no significant differences in all subgroups for survival rates ($P>0.05$).

Growth of Lambs

The least squares means for live weights of the lambs at birth, 3 and 6 months of age are shown in Table 4. Lamb genotype had no significant effect on live weights of lambs at birth, 3 and 6 months of age, while sex and type of birth had highly significant effects ($P<0.001$) on all ages. The lambs born to 4 years old ewes had higher birth weight than those of lambs born to 2 years old ewes ($P<0.05$).

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Table 3
The least squares means (± SE) of survival rates of lambs at 1 and 3 and 6 months of age (Mittelwerte der Überlebensrate der Lämmer im 1. bis 6. Monat)

Item	Survival rate (%)		
	1 month	3 months	6 months[a]
Lamb genotype	ns	ns	ns
W	95.3 ± 3.47	91.2 ± 3.89	90.8 ± 4.13
KWF_2	98.7 ± 4.82	95.7 ± 5.40	94.3 ± 4.43
KWB_1	96.8 ± 3.29	95.6 ± 3.69	93.7 ± 3.92
CWF_2	88.3 ± 3.04	87.3 ± 3.41	86.5 ± 4.10
CWB_1	94.6 ± 2.81	94.2 ± 3.15	93.7 ± 3.80
Age of dam at birth (year)	ns	ns	ns
2	90.4 ± 2.48	87.1 ± 2.79	85.9 ± 3.10
3	95.8 ± 2.69	94.8 ± 3.02	93.7 ± 3.86
4	97.8 ± 4.08	96.6 ± 4.57	95.7 ± 3.47
Year	ns	ns	ns
1998	91.2 ± 4.69	90.7 ± 5.25	89.4 ± 4.73
1999	97.2 ± 2.67	93.7 ± 2.99	92.6 ± 3.17
2000	95.6 ± 2.22	94.2 ± 2.49	93.4 ± 3.72
Sex	ns	ns	
Male	94.2 ± 2.47	91.2 ± 2.77	
Female	95.2 ± 2.30	94.5 ± 2.58	
Type of birth	ns	ns	ns
Single	95.3 ± 2.68	94.5 ± 2.99	93.0 ± 3.74
Twin	94.0 ± 2.27	91.2 ± 2.55	90.6 ± 3.12
Total	94.7 ± 1.97	92.9 ± 2.21	91.8 ± 2.45

ns non significant; [a] only female lambs

Table 4
Number and least squares means (± SE) of live weights of lambs at birth and 3 and 6 months of age (Mittelwerte der Lämmergewichte bei Geburt, nach 3 bzw. 6 Monaten)

Item	Live weights (kg)					
	Birth		3 months		6 months[d]	
	n	means (± SE)	n	means (± SE)	n	means (± SE)
Lamb genotype		ns		ns		ns
W	45	4.4 ± 0.10	40	21.1±0.59	20	31.9 ± 1.03
KWF_2	28	4.3 ± 0.14	28	20.3±0.76	18	29.4 ± 1.49
KWB_1	60	4.1 ± 0.09	58	19.6±0.53	28	30.3 ± 0.92
CWF_2	71	4.2 ± 0.09	60	20.3±0.52	32	30.5 ± 0.10
CWB_1	94	4.1± 0.08	88	19.9±0.45	39	30.1 ± 0.75
Age of dam at birth (year)		*		ns		ns
2	113	4.1 ± 0.07[a]	98	20.0 ±0.42	49	30.3 ± 0.79
3	123	4.1 ± 0.08[ab]	115	20.4 ±0.45	58	30.6 ± 0.82
4	62	4.4 ± 0.12[b]	61	20.2 ± 0.67	30	30.5 ± 1.19
Year		ns		***		***
1998	44	4.3 ± 0.14	35	17.4 ± 0.79[a]	18	25.8 ± 1.34[a]
1999	109	4.3 ± 0.08	98	21.9 ± 0.44[b]	49	31.9 ± 0.84[b]
2000	145	4.1 ± 0.07	141	21.3 ± 0.36[b]	70	33.6 ± 0.68[b]
Sex		***		***		
Male	150	4.3 ± 0.07	137	21.3 ±0.41		
Female	148	4.1 ± 0.07	137	19.2 ± 0.38		
Type of birth		***		***		***
Single	156	4.4 ± 0.07	144	21.9 ± 0.39	79	32.69 ± 0.70
Twin	142	4.0 ± 0.08	130	18.6 ± 0.45	58	28.21 ± 0.82
Regression[c]				1.991***		1.959**
Total	298	4.2 ± 0.06	274	20.24 ± 0.33	137	30.45 ± 0.59

ns non significant; * P<0.05; ** P<0.01; ***: P<0.001
[a, b] Means within a column in a subgroup with different superscripts differ significantly (P<0.05).
[c] Partial regression coefficients of 3 and 6 months weights on birth weights in lambs.
[d] only female lambs

Body Measurements

The least squares means of the body measurements of five lamb genotypes at two measurement periods are given in Table 5. Lamb genotype had significant effect ($P<0.05$) on wither height and body length at 180th days. It had also highly significant effect ($P<0.001$) on the widest circumference of the tail at 90th and 180th days.

Table 5
The least squares means (± SE) of body measurements of lambs at 3 and 6 months of age (Mittelwerte der Körpermaβe nach 3 bzw. 6 Monaten)

Lamb genotype	3 months	6 months[d]
	Wither Height	
	ns	*
W	55.4 ± 0.84	64.3 ± 0.83[a]
KWF_2	54.8 ± 1.41	63.8 ± 1.64[ab]
KWB_1	53.2 ± 1.03	61.1 ± 1.11[b]
CWF_2	55.6 ± 0.99	64.7 ± 1.13[a]
CWB_1	57.0 ± 1.09	65.2 ± 1.03[a]
	Body Length	
	ns	*
W	58.5 ± 1.54	67.8 ± 1.15[a]
KWF_2	56.8 ± 1.98	64.8 ± 1.82[ab]
KWB_1	55.9 ± 1.44	63.6 ± 1.23[b]
CWF_2	57.3 ± 1.39	67.6 ± 1.26[a]
CWB_1	58.8 ± 1.18	67.9 ± 0.93[a]
	Chest Girth	
	ns	ns
W	67.8 ± 1.31	78.1 ± 1.40
KWF_2	64.2 ± 1.68	76.7 ± 2.21
KWB_1	64.0 ± 1.23	77.2 ± 1.50
CWF_2	63.0 ± 1.19	76.5 ± 1.54
CWB_1	63.7 ± 1.01	76.3 ± 1.13
	Cannon Bone Circumference	
	ns	ns
W	6.9 ± 0.17	7.3 ± 0.12
KWF_2	6.7 ± 0.22	7.1 ± 0.20
KWB_1	6.8 ± 0.16	7.1 ± 0.13
CWF_2	6.9 ± 0.15	7.3 ± 0.14
CWB_1	7.1 ± 0.13	7.3 ± 0.10
	The Widest Circumference of Tail	
	***	***
W	38.3 ± 2.02[a]	47.8 ± 2.07[a]
KWF_2	25.3 ± 2.60[b]	28.7 ± 3.28[b]
KWB_1	17.6 ± 1.89[c]	20.6 ± 2.22[c]
CWF_2	28.3 ± 1.83[b]	30.9 ± 2.28[b]
CWB_1	24.5 ± 1.54[b]	27.3 ± 1.68[b]

ns non significant; * $P<0.05$; ***: $P<0.001$
[a, b, c] Means within a column in a subgroup with different superscripts differ significantly ($P<0.05$).
[d] only female lambs

Discussion

Reproductive performances of sheep breeds are generally different. These traits are economically important for a sheep enterprise. Improving reproductive performance is an important objective for increasing the profitability of sheep production. The prolific breeds x indigenous F_1 crossbred ewes have generally better reproductive performance than pure indigenous ewes (GALLIVAN et al., 1993; BUNGE et al., 1995; FADILI et

al., 2000; OZCAN et al., 2001; HASSAN et al., 2002; UNAL et al., 2002b; SEIBERT et al., 2004). As a matter of fact, CWF_1 ewes had the highest oestrus rate, lambing rate and litter size among ewe genotypes. These findings were in agreement with the results reported for crossing prolific breed with indigenous breed (GALLIVAN et al., 1993; BUNGE et al., 1995; FADILI et al., 2000; OZCAN et al., 2001; HASSAN et al., 2002; UNAL et al., 2002b). The findings that CWF_1 ewes had higher reproductive performances in steppe conditions than W breed, local breed in central Anatolian, are important for lamb production. BUNGE et al. (1995) reported that F_1 crossbred ewes produced from Suffolk and Targhee dams and sires of the prolific breeds of Booroola Merino, Finnsheep and Combo-6 and hair breeds of St. Croix and Barbados were mated to Dorset rams. Booroola Merino sired F_1 ewes and Finnsheep sired F_1 ewes had more litter size and longer breeding season than hair breeds sired F_1 ewes. The crossbred ewes produced from prolific D'man breed and indigenous Sardi breed had higher total lamb production than either purebred (BOUJENANE et al., 1991). OZCAN et al. (2001) reported that Chios x Kivircik F_1 ewes had higher reproductive performance than Kivircik ewes. In this study, 4 year old ewes had superior reproductive performance over 2 and 3 year old ewes; however, the difference was only statistically significant for litter size. Results of this study confirm that ewes have an increase in reproductive performance from young through intermediate ages (BUNGE et al., 1995; AKCAPINAR et al., 2000; OZCAN et al., 2001; UNAL et al., 2002b).

Survival of lambs from birth to weaning is a major factor affecting number of lambs weaned per ewe lambing. Lamb survival was greatly influenced by litter size. In general, an increasing litter size increases losses in a more or less exponential way, especially when the environmental conditions are unfavorable (BOUJENANE et al., 1991; UNAL et al., 2002b; KALLWEIT and BAULAIN, 2001). Higher ovulation rate generally leads to higher embryonic mortality. AVDI and CHEMINEAU (1998) reported that ovulation rate of Chios breed was higher in ewes mated in autumn than those mated in spring, but prolificacy was similar in both groups because of higher embryonic mortality in autumn mated ewes. In this study, although CWF_1 ewes had highest litter size, survival rates of C-sired lambs were not statistically differ from K-sired and W lambs at 1, 3 and 6 months of age. That the survival of C-sired and K-sired lambs in steppe conditions were similar to W lambs are beneficial for lamb production. Lamb survival was lower for lambs from young ewes than from ewes at intermediate ages, in agreement with the results of majority of the published studies (BOUJENANE et al., 1991; BUNGE et al., 1995; AKCAPINAR et al., 2000; UNAL et al., 2002b). In this study, male and female lambs did not differ in terms of survival rate, in agreement with the results from other studies (BOUJENANE et al., 1991; UNAL et al., 2002b) although a more common pattern is for lower survival for males (GALLIVAN et al., 1993; BUNGE et al., 1995; AKCAPINAR et al., 2000).

Growth traits are very important for sheep production. Rapid growth of lambs is desirable because it is a way of improving sheep production efficiency. Genetic and many non-genetic factors (sex of lamb, year, age of dam, type of birth, season, mother's milk yield) can affect growth traits in lambs. In this study, the growth performance of the lambs from all genotypes investigated was found to be similar. That the growth of C-sired and K-sired lambs in steppe conditions was similar to W lambs is an advantage for lamb production. Male lambs and single lambs have higher

live weights than others. These findings were in agreement with the results of majority of the previously published literatures (GALLIVAN et al., 1993; AKCAPINAR et al., 2000; UNAL et al., 2002b; DOBEK et al., 2004).

Body measurements of lambs show body frame of lambs. K-sired lambs at 3 and 6 months of age had lowest body measurements among genotypes. When C and K and W pure breeds are taken into consideration, K breed has the lowest measurements. For this reason, K-sired lambs might have lower measurements than others.

If sheep production is to remain a viable industry, producers should concentrate on providing a product that fits consumer and market demands. In Turkey, carcasses of fat tail sheep have generally lower price than those of non-fat tail sheep. The widest circumference of tail is one of the indicators of tail weight. The crossbred lambs, especially KWB_1 lambs, had highly lower circumference of tail.

Conclusion

The results showed that reproductive performance of ewes was the highest in Chios crossbred while survival and growth of lambs were similar in all genotypes in steppe conditions.

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