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## **EFFECT OF SOME FACTORS ON THE WOOL YIELD AND STAPLE LENGTH AT DIFFERENT AGES IN SHEEP FROM THE NORTHEAST BULGARIAN FINE FLEECE BREED - SHUMEN TYPE**

G. STAIKOVA and N. STANCHEVA  
*Agricultural Institute, BG-9700 Shumen, Bulgaria*

### **Abstract**

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A study was carried out in order to establish the influence of some sources of specific variance on the wool yield and staple length in 1981 sheep at different ages, from the Northeast Bulgarian fine fleece breed – Shumen type, born during the period 1990 – 2005. All estimations and the variance analysis were done on the basis of multifactor linear statistical models (Harvey, 1990).

The year of birth was a significant source of variance with respect to the wool yield and staple length at all ages studies. Differentiation between the breeding lines of the Northeast Bulgarian fine fleece breed by the wool yield and staple length was established. There was a trend towards heterosis manifestation with respect to both traits in sheep, product of interline mating, at all ages studied.

*Key words:* wool yield, staple length, year of birth, breeding lines

### **Introduction**

The considerable reduction of the sheep population of wool direction, result of the new economic conditions, urges reconsideration of the criteria of importance of the productive traits. The dynamic development of fine fleece sheep breeding motivates the new research, studies and decisions for stimulating the sheep breeding.

The results obtained can serve as a basis for directing the breeding work to achieve higher effectiveness and adequacy to the market. The main part of the investigations into the wool yield in different fine fleece breeds is focused on establishing the variability of wool yield under the influence of some genetic and

non-genetic factors (Boikovski, 1993, 1994; Mihailova, 1996; Dimitrov, 1998; Iliev, 1998, 1999, 2003, 2006; Chincheva, 2000; Slavova, 2002; Panayotov, 2002; Iliev, 2003; Slavov, 2007, 2008; Stainhagen et al., 1986; Naser et al., 2004).

The objective of this study was to establish the effect of some sources of specific variance on the wool yield and staple length in sheep from the Northeast Bulgarian fine fleece breed – Shumen type.

### **Material and Methods**

Subject of the study were 1981 sheep from the Northeast Bulgarian fine fleece breed – Shumen type at different ages, from 19 genealogical lines, for a pe-

riod of 14 years (1990 – 2005).

The following traits were studied: wool yield at 1.5 year up to 6.5 years of age and staple length at 1.5 year and 2.5 years of age. The information from the breeding books was used. The data was obtained by the standard methods and directions provided by the Instruction on control of productive traits and complex assessment of the fine fleece sheep breeds (2008).

All estimations and variance analysis were done by multifactor linear statistical models (Harvey, 1990).

## Results and Discussion

The average wool yield obtained from the Northeast Bulgarian fine fleece sheep - Shumen type varied by ages from 6.804 kg to 10.344 kg (Table 1). Slavov (2001) reported higher data for this trait in the Dobrudzha type of the same breed. In comparison with the research of other fine fleece breeds raised in Bulgaria, our results were close to those obtained by Tsenkov (1997) for the Thracian fine fleece breed and higher than those obtained by Iliev (2006) for the Karnobat fine fleece breed. The variation coefficients were within the range from 14.51% to 19.62%. This fact proved that the deviation from the mean was within normal limits for this trait. The values of the mean accuracy E were low from 0.34% to 0.72% which showed that the results were representative for the whole population. The highest wool yield was recorded at 1.5 year of age – 10.344 kg which was approximately higher by 30% than the wool yield at

the rest ages since the highest wool yield was obtained for a period of 18 months of wool growth. The results for the staple length were analogical. The value of staple length at 1.5 year of age was higher by 37.58% than the value at 2.5 years of age. Those values were higher than the values obtained by Slavov (2001) for the Northeast Bulgarian fine fleece breed and for the Northeast Bulgarian fine fleece breed x the Australian merino. The data of Todorova (1996) for the Ascanian breed and of Slavova (2000) for the Thracian fine fleece breed was lower. The trait variation and the values of the mean accuracy E were comparatively low and almost identical at both ages.

The average wool yield in sheep from the Northeast Bulgarian fine fleece breed – Shumen type at 1.5 year was higher by 37.92 % than the standard requirements for fine fleece breed, by 26.91 % at 2.5 years and by 33.71 % at 3.5 years of age. The data for staple length was analogical. The average trait value at 1.5 year was higher by 44.43 % than the standard provided by the Instruction on control of productive traits and complex assessment of sheep from fine fleece direction (2008) and by 35.23 % at 2.5 years of age. Those results gave us grounds to conclude that due to long years of selection by both traits, their values almost reached the genetic potential of the breed.

The year of birth significantly influenced both traits at all ages studied ( $P < 0.001$ ) (Table 2). The results from studies of fine fleece breeds reported by Todorova (1996), Tsenkov (1997), Iliev (1998) and Slavova (2002) were analogical.

The sire's line significantly influenced the wool yield

**Table 1**

**Average values of the wool yield and staple length by ages in sheep from the Northeast Bulgarian breed - Shumen type**

Age	Wool yield				Staple length			
	n	x	C	E	n	x	C	E
at 1.5 year of age	1811	10.344	14.51	0.34	1795	15.165	9.87	0.23
at 2.5 years of age	1602	6.98	17.14	0.43	1617	9.466	9.49	0.23
at 3.5 years of age	1357	7.354	17.63	0.48				
at 4.5 years of age	1095	7.133	17.36	0.52				
at 5.5 years of age	677	7.302	16.23	0.63				
at 6.5 years of age	420	6.804	19.62	0.72				

**Table 2**  
**F – criterion for the analysis of variance of the wool yield and staple length**  
**in sheep from the Northeast Bulgarian breed - Shumen type**

Traits	Sources of variability		
	year of birth	line	type of mating
wool yield			
at 1.5 year of age			
Df	13	19	2
F - criterion	22.2	2.79	0.69
F - test	+++	+++	n.s.
R= 0.46			
at 2.5 years of age			
Df	13	19	2
F - criterion	41.34	1.39	5.53
F - test	+++	n.s.	++
R= 0.55			
at 3.5 years of age			
Df	12	19	2
F - criterion	42.59	2.14	5.89
F - test	+++	++	++
R= 0.63			
at 4.5 years of age			
Df	12	19	2
F - criterion	26.79	1.13	1.05
F - test	+++	n.s.	n.s.
R= 0.56			
at 5.5 years of age			
Df	11	17	2
F - criterion	8.73	2.22	1.78
F - test	+++	++	n.s.
R= 0.53			
at 6.5 years of age			
Df	10	14	2
F - criterion	9.76	0.87	0.02
F - test	+++	n.s.	n.s.
R= 0.58			
staple length			
at 1.5 year of age			
Df	13	19	2
F - criterion	64.21	1.67	1.66
F - test	+++	+	n.s.
R= 0.67			
at 2.5 years of age			
Df	13	19	2
F - criterion	97.47	1.22	1.2
F - test	+++	n.s.	n.s.
R= 0.75			

**Table 3**  
**LS-estimations of the effect of the year of birth on the wool yield at different ages**  
**in sheep from the Northeast Bulgarian breed - Shumen type**

Year of birth	Amount of unwashed wool, kg											
	at 1.5 year of age		at 2.5 years of age		at 3.5 years of age		at 4.5 years of age		at 5.5 years of age		at 6.5 years of age	
	n	a	n	a	n	a	n	a	n	a	n	a
1990	137	0.9	124	1.044	118	2.7	107	0.629	87	0.705	59	1.002
1991	133	0.519	103	0.845	92	-0.342	59	0.032	28	0.275	11	1.009
1992	140	-0.923	122	-0.786	77	-0.612	42	-0.004	30	0.13	21	0.096
1993	178	-1.466	116	-0.057	103	-0.668	88	0.225	65	0.048	12	0.869
1994	122	0.504	111	-0.051	94	0.078	64	0.824	41	-0.114	25	-1.134
1995	148	0.527	125	0.312	114	0.576	96	0.096	68	-0.747	7	-1.925
1996	129	-0.342	111	0.454	95	-0.411	66	-0.613	25	-1.103	8	0.565
1997	139	0.009	127	-0.068	117	-1.26	88	-0.946	13	-0.314	38	0.228
1998	131	-0.144	127	-0.337	122	-1.172	111	-0.707	43	0.892	83	-0.475
1999	132	-0.796	128	-0.517	118	-0.81	110	1.674	100	0.557	75	0.739
2000	125	-0.135	119	-1.234	116	0.78	90	0.212	80	-0.657	81	-0.973
2001	129	0.474	128	1.651	114	0.259	104	-0.079	97	0.328		
2003	85	0.366	81	-0.03	77	0.882	70	-1.342				
2005	83	0.508	80	-1.227								

**Table 4**  
**LS-estimations of the effect of the year of birth on the staple length at different ages**  
**in sheep from the Northeast Bulgarian breed - Shumen type**

Year of birth	Staple length, cm			
	at 1.5 year of age		at 2.5 years of age	
	n	a	n	a
1990	138	0.058	132	0.585
1991	140	-0.922	115	0.339
1992	137	-2.615	104	-2.341
1993	156	-1.565	119	0.163
1994	122	0.751	111	0.145
1995	147	-0.350	133	-0.196
1996	130	-0.089	111	2.299
1997	139	2.505	128	0.732
1998	131	0.398	127	0.005
1999	132	-0.259	130	0.595
2000	125	2.190	118	0.408
2001	129	0.375	128	-0.207
2003	86	-0.158	80	-0.633
2005	83	-0.319	81	-1.895

**Table 5**  
**LS-estimations of the effect of the line on the wool yield at different ages**  
**in sheep from the Northeast Bulgarian breed - Shumen type**

Line	Amount of unwashed wool, kg											
	at 1.5 year of age		at 2.5 years of age		at 3.5 years of age		at 4.5 years of age		at 5.5 years of age		at 6.5 years of age	
	n	a	n	a	n	a	n	a	n	a	n	a
251	45	-0.159	37	0.051	40	0.112	36	0.061	26	-0.313	20	-0.343
68	35	0.308	34	0.354	1	-2.298	1	-0.469	1	2.041		
1035	37	-0.137	34	0.394	33	0.106	30	0.412				
441	4	0.683	4	-0.828	1	1.067	1	0.823				
40199	210	0.759	204	0.467	196	0.57	177	0.036	114	-0.132	99	-0.029
40368	100	-0.163	88	0.082	75	-0.006	54	-0.083	9	0.441	3	0.616
528	38	0.028	31	-0.053	28	-0.141	21	0.097	15	0.599		
576	85	0.04	67	0.04	53	0.243	33	-0.172	25	0.205	4	-0.105
583	285	0.043	266	0.202	248	0.137	211	-0.196	152	-0.265	120	-0.274
5032	43	-1.403	40	-0.578	40	-0.926	27	-0.908	19	-1.076	13	-0.672
6182	60	-0.386	51	0.005	42	-0.065	36	-0.115	14	-0.935	4	1.19
757	30	-0.039	29	-0.261	27	-0.173	18	-0.221	14	-0.217		
7120	21	0.391	17	-0.084	15	0.743	14	0.078	9	0.755	5	0.291
7418	91	0.167	78	0.106	62	0.340	44	-0.089	33	0.263	19	0.517
72776	70	0.268	66	0.155	18	-0.053	12	0.794	12	-0.298	10	-0.356
86	1	-0.843	1	-0.933	1	-0.625	1	-0.476	1	-1.086	1	-0.7
918	61	-0.046	45	0.446	37	0.626	27	-0.055	17	-0.532	7	-0.556
95474	13	0.26	11	0.202	10	-0.119	9	0.387	8	0.783	5	0.471
951349	91	0.242	67	-0.003	52	0.131	43	0.162	28	-0.102	3	0.171
non-lineal	491	-0.014	432	0.236	378	0.331	300	-0.065	180	-0.132	107	-0.221

at 1.5 year ( $P \leq 0.001$ ), at 3.5 and at 5.5 years of age ( $P \leq 0.01$ ) and the staple length at 1.5 year ( $P \leq 0.05$ ). The type of mating significantly influenced the wool yield at 2.5 and 3.5 years of age ( $P \leq 0.01$ ). The determination coefficient  $R$  for the wool yield varied from 0.46% to 0.63%, and for the staple length - from 0.67% to 0.75% which showed that a large part of the variation by these traits was due to the influence of the factors included in the model and the results obtained were representative.

The LS- estimations for the average wool yield in the animals born in 1990 for all ages studied had high and positive values. The same trend referred to the animals born in 1991 except at 3.5 years of age, and

to the animals born in 2001 except at 4.5 years of age. The animals born in 1995 had positive estimations up to 5.5 years of age. The sheep born in 1992 up to 5.5 years of age and in 1998 at all ages, except 5.5 years, had lower wool yield than the average for the population. The values for animals born in the rest years of the period studied were not unidirectional (Table 3).

With respect to the staple length the animals born in 1997 and 2000 considerably exceeded the other animals at both ages studied and also the animals born in 1996 but only at 2.5 years of age (Table 4). The animals born in 1992 had negative LS-estimations at both ages, and those born in 1993 – at 1.5 year and

**Table 6**  
**LS-estimations of the effect of the line on the staple length at different ages in sheep from the Northeast Bulgarian breed - Shumen type**

Line	Staple length, cm			
	at 1.5 years of age		at 2.5 years of age	
	n	a	n	a
251	46	-0.018	42	-0.062
68	35	0.11	35	0.361
1035	38	-0.177	33	-0.322
441	4	-0.172	3	-0.412
40199	210	0.209	204	-0.139
40368	101	-0.851	89	-0.209
528	37	0.431	33	0.279
576	84	-0.085	65	-0.124
583	280	-0.037	270	-0.15
5032	43	0.51	40	0.379
6182	60	-0.37	52	-0.199
757	30	0.384	29	0.036
7120	21	-0.192	18	-0.195
7418	92	-0.052	77	-0.13
72776	70	0.149	66	0.018
86	1	-0.166	1	0.742
918	59	-0.043	44	0.133
95474	13	0.099	13	0.042
951349	81	0.168	67	0.001
non-linear	490	0.103	436	-0.05

in 2000 – at 2.5 years of age. The influence of the year of birth was highly significant ( $P \leq 0.001$ ). It should be noticed that the animals born in 1992 had high and negative LS-estimations for both traits. The high and positive estimations of the staple length in the animals born in 1997 and in 2000 and almost zero values of the wool yield for the first year and the negative values at both ages in the animals born in 2000 did not give us grounds to presume positive correlation between both traits. Line 7120 had positive effect on the wool yield at all mentioned ages, except at 2.5 years of age (Table 5). The LS-estimations were positive in the animals from line 7418 except at 4.5 years and line 95474 except at 3.5 years of age. The deviations from the average wool yield of the herd of the breeding lines 5032, 86 and 757 were high and positive at all ages studied. The LS-estimations in the non-linear animals were negative except at 2.5 and 3.5 years of age.

The sheep from the following lines - 5032, 528, 757, 72776, 951349, 068 and 95474 exceeded the rest animals by the staple length at both ages studied (Table 6). The LS-estimations of lines 40368, 6182, 7120, 01035, 441, 7418, 583, 576 and 0251 were negative at both ages. The influence of the breeding line was significant ( $P \leq 0.05$ ) at 1.5 year of age. Line 95474 positively influenced both traits. The data analysis showed that there was certain differentiation between the lines of the Northeast Bulgarian fine fleece sheep – Shumen type by the wool yield and staple

**Table 7**  
**LS-estimations of the effect of type of mating on the wool yield at different ages in sheep from the Northeast Bulgarian breed - Shumen type**

Type of mating	Amount of unwashed wool, kg											
	at 1.5 years of age		at 2.5 years of age		at 3.5 years of age		at 4.5 years of age		at 5.5 years of age		at 6.5 years of age	
	n	a	n	a	n	a	n	a	n	a	n	a
Intraline	46	-0.085	42	-0.02	38	0.289	35	-0.115	21	-0.205	17	0.005
Interline	897	0.122	792	0.239	656	0.133	523	0.16	342	0.259	212	0.027
Undefined	868	-0.038	768	-0.219	663	-0.422	537	-0.045	314	-0.054	191	-0.032

**Table 8**

**LS-estimations of the effect of type of mating on the staple length at different ages in sheep from the Northeast Bulgarian breed - Shumen type**

Type of mating	Staple length, cm			
	1.5 years of age		2.5 years of age	
	n	a	n	a
Intraline	46	0.183	44	-0.024
Interline	881	0.052	799	0.089
Undertified	868	-0.235	774	-0.065

length but for the second trait the differentiation was more slightly expressed.

The animals, product of interline mating, had positive LS-estimations for the wool yield at all ages studied (Table 7). The LS-estimations in sheep with unidentified mating were negative at all ages studied. The LS-estimations in sheep with interline mating were also negative except at 3.5 and 6.5 years of age. The type of mating had significant influence ( $P \leq 0.01$ ) at 2.5 and 3.5 years of age.

The staple length in the animals, product of interline mating, was over the average for the population at both ages. The LS-estimation in sheep with interline mating was negative at 2.5 years of age and the animals with unidentified origin had lower LS-estimation than the other animals at both ages (Table 8). The results were analogical for both traits. A trend could be indicated

for some heterosis effects in sheep, product of interline mating.

The heritability values for the wool yield at different ages were high and varied from 0.491 to 0.603 and for the staple of length – from 0.890 to 0.921. The high value of the additive heritability component is a prerequisite for successful selection by phenotype in the herd and shows presence of reserves for a great genetic gain.

Chincheva (2000) also established high values of the heritability coefficient for the traits studied in the Northeast Bulgarian fine fleece breed - Shumen type and the Caucasian breed. Slavov (2008) reported average to high heritability values for the wool yield at 1.5 and 2.5 years of age and average values for the staple length in sheep from the Northeast Bulgarian fine fleece breed – Dobrudzha type (Table 9).

**Table 9**

**Heritability coefficients ( $h^2$ ) of the wool yield and staple length at different ages in sheep from the Northeast Bulgarian breed - Shumen type**

Traits	n	$h^2 \pm S h^2$
Wool yield, kg		
at 1.5 year of age	1319	0.554 ± 0.126
at 2.5 years of age	1169	0.603 ± 0.144
at 3.5 years of age	978	0.526 ± 0.130
at 4.5 years of age	794	0.491 ± 0.140
Staple length, cm		
at 1.5 years of age	1304	0.921 ± 0.171
at 2.5 years of age	1180	0.890 ± 0.169

## Conclusions

The year of birth was a highly significant source of variability with respect to the wool yield and staple length at all ages studied ( $P \leq 0.001$ ).

Differentiation between the lines of the Northeast Bulgarian fine fleece sheep – Shumen type by the wool yield and staple length was established but for the second trait the differentiation was more slightly expressed.

The variance analysis of the type of mating showed a trend towards heterosis manifestation with respect to both traits in sheep, product of interlines mating.

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