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WOOL PRODUCTION IN SOME FAT-TAILED IRANIAN SHEEP BREEDS

I – SOME QUANTITATIVE CHARACTERISTICS OF KARAKUL, MEHRABAN, NAEINI, GHEZEL AND BAKHTIARI BREEDS[1]

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ABSTRACT

Some quantitative aspects of wool production were compared among the Karakul (301), Mehraban (536), Naeini (366), Ghezel (162), and Bakhtiari (131) ewes. The records included semi-washed fleece weight, clean fleece weight and percent yield. Breed, age of ewe and year of production were considered as the main factors influencing production.

Breed, age of ewe and year had highly significant effects on all the traits studied. The average semi-washed fleece weight was 1.76, 1.42, 1.22, 1.08 and 0.96 kg for Karakul, Ghezel, Bakhtiari, Naeini and Mehraban respectively, all of which differed significantly from each other. There were significant differences between all the breeds for clean fleece weight with the same order as for semiwashed fleece weight. Since the animals were washed prior to shearing, as a common practice in Iran, the estimated percent yiled was very high (82.5%). The Karakul had a significantly higher percent yield than the Mehraban and Naeini breeds, but other breeds did not differ significantly.

Yearling ewes produced significantly less semi-washed wool and clean fleece, than the older ewes (two to five years old). The average semi-washed fleece weight and clean

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fleece weight were both significantly more in 1973 than in 1974, but percent yield was higher in 1974.

INTRODUCTION

The carpet industry plays an important role in the national economy of Iran. A great majority of the tribal women, as well as those living in the villages, are engaged in this industry and therefore, it is an important source of family income for farmers and tribal people. The carpet quality and price, depend greatly on the quality of the available wool in each area. As the breed of sheep and the wool quality of each breed differs in different regions, the form and quality of carpet also differ and is specific for each part of the country. Quantitative and qualitative improvement of wool production will therefore have a marked effect on the sheep and carpet industry in Iran.

Information on the wool producing ability and wool characteristics of different Iranian carpet-wool breeds is very limited. Almost all of the Iranian sheep breeds produce poor quality wool of relatively little commercial value. The wool produced by some of the breeds is too hairy and dark (black or dark brown) to be used for high quality carpet.

The purpose of this study was to compare semi-washed and clean fleece weight of five Iranian fat-tailed carpet-wool breeds of sheep and evaluate the relative importance of some of the factors affecting these traits.

MATERIALS AND METHODS

Breeds: This study involved five fat-tailed carpet-wool breeds of Iranian sheep;

Karakul, Mehraban, Naeini, Bakhtiari and Ghezel. The characteristics of the first four breeds are described by Farid and Makarechian (6). Some of the characteristics of the Ghazel breed are briefly described here.

The Ghezel is one of the largest breeds of sheep in Iran. It is distributed in the north-western part of the country, in which it is also known as Afshari. The average precipitation in this area is considerably more than in most other parts of Iran with long, cold winters. There are vast mountain ranges and grasslands which can be classified as fair to good pasture. The Ghezel is believed to be one of the most prolific and best milk-producing breeds in the country. The typical sheep is reddish brown in color and rams are polled.

Source of the data: In 1973, Ghezel and Bakhtiari sheep were purchased from the large flocks which are believed to have pure and typical animals. The college flock consisting of Karakul, Mehraban and Naeini, which was established in 1971, was also enlarged by introducing some more Naeini and Mehraban sheep in 1973. No classical selection for economic traits has been practiced on the flock since its establishment.

A total of 1,496 records of annual semi-washed fleece weight of ewes, consisting of 301 Karakul, 536 Mehraban, 366 Naeini, 162 Ghezel and 131 Bakhtiari, and 1,333 records of clean fleece weight, representing two successive production years (1973 and 1974) were used in this study. Only the records of the ewes which raised one lamb to weaning were used, with the exception of yearlings which were mated at approximately one and half years of age. Since there was only a limited number of rams, their records were excluded. The records of the yearling ewes which were born at the station, and were raised under different nutritional and management practices, were also excluded. Feeding and management practices of the sheep are described by Farid and Makarechian (7).

Shearing and Sampling Method: Shearing was started in late April each year as is common in the area. At shearing time, most of the ewes were nursing their lambs. The animals were shorn with the commercial Iranian shearing device which resembles scissors with long blades. The process is extremely slow and a considerable amount of wool is usually left on the animal. It is a routine practice to wash the sheep a few days prior to shearing, which facilitates shearing. The animals were washed rapidly in the cold running water of a stream about four days before shearing. Since some of the wool impurities are washed out, the wool obtained is known as "semi-washed" wool. At shearing, the total fleece weight was recorded to the nearest 10 grams.

The wool samples were taken from midway between the scapula and hip joint, and between the back bone and belly. Differences in average clean yield of wool from the various parts of the body are clearly evident, and midside samples have been found to give the most accurate estimates of clean yield of the whole fleece than any other location (11, 12, 13, 14).

Each wool sample weighed approximately 30 grams which was not clipped closely. There are many reports which indicate that this sample weight is sufficient for accurate determination of clean fleece weight (11, 14, 18). After shearing, the samples were immediately placed in moisture-proof nylon bags until they were scoured.

Scouring Method: A small subsample was taken from each sample bag for qualitative work, and the remainder was weighed and dried in conditioning oven at 105 C for four hours to obtain the moisture-free weight. The dried sample was reweighed and the loss in weight determined the moisture content of the wool. The fleece samples were then opened by hand to remove loose dirt and chaff, and were put in a rigid plastic sieve, in order to avoid wool compaction during washing operations. The sieve was put in a cheese cloth and was washed by a washing machine in five stages. In the first stage, the samples were washed in a simple washing machine with cold water for fifteen minutes. Water was turning horizontally and at a low speed in this case. Then the samples were washed twice with a commercial detergent poydder by an automatic washing machine. In the first washing, the water temperature was 40 C and samples were turned about 30 times. In the second washing, water temperature was 60 C and the samples turned 40 times. The samples were washed twice more with the same machine, repeating the previous washing except that no detergent was used. Each stage required about 35 minutes, and at the completion of each stage the water content of the machine was drained completely. Then the samples were put in an oven for about 16 hours (over-night) and weighed. The percentages of yield were based on this bone-dry determination of clean wool. Bone-dry determinations free the wool from moisture variation, giving a controlled basis for analytical comparison. The method of scouring side samples for yield determination has been shown to be reasonably accurate as compared with other techniques (15, 19, 20).

To estimate the clean yield of the whole fleece from the small sample, the specific regression equation between those two measurements within each breed should be developed. It is apparent that percentage of clean yield obtained from a small side sample would be adequate for use in a breeding program, where it would be used to compare individuals or groups of individuals within a flock.

In order to obtain grease fleece weight and clean fleece weight on a commercial basis which contains 12% moisture, the bone-dry weights were divided by 0.88.

Analysis of the Data: The least-squares method as outlined by Harvey (9) was used to analyze the data. For semi-washed fleece weight, the constant were fitted for breed, age of ewe, year of production and birth year of ewe. Records of six-year-old and five year-old ewes were combined due to the small number of observations. Differences between ewes born in different years arise from different climatic and nutrition conditions and management practices operating in the year of birth. Since this factor was not an important source of variation, it was eliminated from the model and the data were re-analyzed. Breed, age of ewes and year of production were considered as the main factors for analyzing the other traits. Interactions between the main factors were not considered in the model because some of the subclasses (breed and age groups within breeds) did not have any observation (Table 1).

Pair-wise tests of significance for difference between means were completed using the Duncan's Multiple Range Test as modified by Kramer (5, 10). Standard errors of different means were calculated by the appropriate inverse elements of the variance-covariance matrix.

RESULTS AND DISCUSSION

Breeds: Breed was the greatest source of variation in wool production and had a highly significant effect on all the traits studied ($P < 0.01$) as shown in Table 2. There were highly significant differences between all the breeds for semi-washed fleece weight moisture adjusted (12%) semi-washed fleece weight and moisture-adjusted clean fleece weight (Table 3). The Karakul ranked first, followed by Ghezel, Bakhtairi, Naeini and Mehraban in semi-washed fleece weight and moisture adjusted semi-washed fleece weight. Breed accounted for 40.58, 42.43, and 43.30 percent of the total variation of semi-washed fleece weight, moisture adjusted semiwashed fleece weight and clean fleece weight, respectively.

The average 82.5 percent yield indicated that a considerable amount of wool impurities was removed as a result of washing the animals prior to shearing. The low shrinkage of the wool of these breeds may also be due to the low grease content of carpet-wool breeds as compared with that of the world famous wool-producing breeds. Ragab and

Table 1. The distribution of ewes with respect to year, breed and wool color

Breed	Color	Year	Age (year) 1	2	3	4	5	6	Total	Breed total
Karakul	Gray or black	1973	6	81	61	1	–	–	149	301
		1974	–	8	86	57	1	–	152	
Mehraban	Brown (mainly) white, black or spotted	1973	9	74	40	20	6	–	149	536
		1974	136	42	112	49	39	9	387	
Naeini	White with black nose, muzzle and lower parts of feet	1973	14	45	8	82	1	–	150	366
		1974	2	30	59	20	100	5	216	
Ghazel	Reddish brown	1974	162	–	–	–	–	–	162	162
Bakhtiari	White (mainly) black, brown or spotted	1974	49	27	25	12	18	–	131	131

Table 2. Analysis of variance for some of the wool production traits (mean squares).

Source of variation	d. f.	Semi-washed fleece weight	d. f.	Percent moisture	Semi-washed fleece weight (1)	Percent yield	Clean fleece weight (1)
Breed	4	33.16**	4	94.25**	34.63**	594.50**	28.46**
Age	4	0.93**	4	40.13**	0.77**	598.75**	0.70**
Year	1	12.17**	1	840.25**	12.88**	26269.00**	0.74**
Error	1486	0.12	1323	11.09	0.13	181.33	0.11
Percent of total Variation accounted for		45.44		8.58	42.27	11.46	44.64

(1) 12 percent moisture adjusted
** Significant at $P < .01$

Table 3. Least-squares means and standard errors by breed, age of ewe and year of production and test of significances for differences between means

Main factors	Subclass	No. of ewes	Semi-washed fleece weight kg	No. of ewes	Semi-washed fleece weight* kg	Clean fleece weight kg	Yield %	Moisture %
	Karakul	301	1.76 ± 0.02 a**	284	1.85 ± 0.02a	1.57 ± 0.02 a	85.0 ± 0.9a	6.8 ± 0.2b
Breed	Mehraban	536	0.96 ± 0.02 b	460	0.99 ± 0.02b	0.78 ± 0.02 b	81.4 ± 0.7bc	8.2 ± 0.2a
	Naeini	366	1.08 ± 0.02c	328	1.12 ± 0.02c	0.91 ± 0.02c	81.7 ± 0.8bc	7.6 ± 0.2ac
	Ghezel	162	1.46 ± 0.03d	147	1.52 ± 0.04d	1.26 ± 0.04d	82.5 ± 1.5ac	7.3 ± 0.4bc
	Bakhtiari	131	1.22 ± 0.03e	114	1.28 ± 0.04d	1.00 ± 0.03e	82.0 ± 1.4ac	7.5 ± 0.3ab
	1	378	1.18 ± 0.02a	350	1.24 ± 0.02a	1.01 ± 0.02a	82.1 ± 0.9a	6.7 ± 0.2a
Age of Ewe	2	307	1.34 ± 0.02b	277	1.30 ± 0.02ab	1.12 ± 0.02b	81.0 ± 0.9a	7.7 ± 0.2b
(year)	3	391	1.34 ± 0.02b	346	1.31 ± 0.02ab	1.16 ± 0.02b	82.8 ± 0.9a	7.8 ± 0.2b
	4	241	1.31 ± 0.02b	204	1.35 ± 0.03b	1.14 ± 0.03b	85.3 ± 1.0b	7.6 ± 0.3b
	5 & 6	179	1.28 ± 0.03b	156	1.37 ± 0.03b	1.12 ± 0.03b	81.3 ± 1.3a	7.7 ± 0.3b
Production	1973	448	1.41 ± 0.02a	411	1.48 ± 0.02a	1.13 ± 0.02a	76.8 ± 0.8a	6.5 ± 0.2a
Year	1974	1048	1.18 ± 0.01b	922	1.22 ± 0.01b	1.08 ± 0.01b	88.2 ± 0.5b	8.5 ± 0.1b
Overall Mean		1496	1.30 ± 0.01	1333	1.35 ± 0.01	1.11 ± 0.01	82.5 ± 0.5	8.5 ± 0.1

*12% moisture adjusted

**All means within a column and within a particular sub-class not having the same letter differ significantly ($P < 0.05$)

Ghoneim (16) reported 85.8 and 87.7% yield for Egyptian Barki sheep of 6 and 12 months of age, respectively, which is comparable with these estimates, supporting the finding of a low amount of grease and/or other wool impurities for the carpet-wool breeds.

The breeds ranked the same for percent yield as for wool production, although the differences were not significant in most of the comparisons. The Karakul had a significantly higher percent yield (85.0%) than the Mehraban and Naeini breeds, but there were no significant differences among the Mehraban, Naeini, Ghezel and Bakhtiari. Table 3 shows that the breeds rank in the same order for wool weight and percent yield, but this positive association between wool production and clean yield is not consistently present when within-breed relationships are considered (Table 4). The regression coefficient of percent yield on semi-washed wool were variable for different breeds, ranging from +4.24 (for Bakhtiari) to -7.97 percent yield (for Naeini) for each Kg increase in semiwashed wool. Similar variations were found for correlation coefficients which varied from significant and positive (0.15 for Bakhtiari) to highly significant and negative (-.27 for Naeini). Therefore, within some of the breeds, such as Bakhtiari, it is reasonable to expect relatively less wool impurities in wool shorn from high-producing animals, but the opposite relationship existed for some other breeds (Karakul, Naeini and Mehraban).

Although the animals were washed a few days prior to shearing, the average moisture content of the wool samples was low (8.5%), due to the low relative humidity of the area. The breeds' rank for moisture content was exactly opposite to their rank for wool production traits and percent yield. Within all 5 breeds, the regression coefficients of percent moisture on semi-washed fleece weight were also negative, ranging from -.02 (Ghezel) to -2.21 (Naeini), and the corresponding correlation coefficients ranging from zero to -.25 ($P < 0.01$).

Karakul wool had the lowest moisture content (Table 3) but its means did not

Table 4. Relationships between some wool production traits.

Independent variable	Breed	Regression	Correlation
		Percent moisture	
Semi-washed fleece weight	Karakul	–.09	-.02
	Mehraban	– 1.57*	– .12*
	Naeini	– 2.21**	– .25**
	Ghezel	– .02	0.00
	Bakhtiari	– .94	– .06
		Percent Yield	
Semi-washed fleece weight	Karakul	– 2.24*	– .11*
	Mehraban	– 7.84**	– .23**
	Naeini	– 7.96**	– .27**
	Ghezel	1.98	0.07
	Bakhtiari	4.24*	0.15*
		Moisture-adjusted clean fleece weight	
Moisture-adjusted semi-washed fleece weight	Karakul	0.78**	0.88**
	Mehraban	0.72**	0.91**
	Naeini	0.71**	0.89**
	Ghezel	0.91**	0.94**
	Bakhtiari	0.95**	0.95**
		Percent Yield	
Percent Moisture	Karakul	– .18	– .04
	Mehraban	0.10	0.04
	Naeini	0.37*	0.11*
	Ghezel	– .63**	– .23**
	Bakhtiari	– .81**	– .42**

*Significant at $P < .05$
** Significant at $P < .01$

differ significantly from those of the Ghezel and the Bakhtiari breeds, which had significantly less water content than the Mehraban. The Mehraban fleece which had the highest moisture content did not differ significantly from the Naeini and Bakhtiari breeds. The differences between the moisture content of the wool in these breeds are probably due to the fact that various wool fractions have different mositure affinities and therefore differences in wool compoenents will cause differences in moisture content. The wool fiber is moderately hygroscopic, suint is very hygroscopic and wax and dirt are relatively non-hygroscopic (3). Therefore, the moisture content of any wool sample in a specified atmosphere will partially depend upon the relative amount of the different wool fractions. Table 4 shows the relationship between percent moisture and percent yield within each breed. The correlation coefficients ranged from positive and significant (0.11 for Naeini) to negative and highly significant (-.42 for Bakhtiari). As most of the between and within breed relationships indicated, a higher percent yield is indicative of a lower moisture content.

The average clean fleece weight of these breeds (1.11 kg) is very low compared with that of improved wool-producing breeds. Semi washed fleece weights cannot, of course, be compared with the greasy weights quoted for other breeds. Demururen *et al.* (4), studying the Ghezel (Kizil), Kellakui, Bakhtiari and Baluchi (Kellakui and Baluchi being different strains of Naeini) breeds, estimated the fleece production of ewes to be 2.15, 1.63, 2.29 and 2.49 kg respectively. The clean fleece weights of these breeds, and the nutritional level of the flock have not been reported.

Age of Ewe: Age of ewe had a highly significant effect on all the traits studied (Table 2), although this factor accounted for only about one percent of the total variation of each of the traits. Yearling ewes produced significantly less semi-washed and clean wool as compared with the other age groups (Table 3). Wool production reached its maximum at two to three years of age and then declined gradually but not significantly.

Several studies have reported the significant effect of age on wool production and shown that the youngest and oldest sheep produced less raw fleece than middle-aged animals. Slen and Bankey (21) reported that in the Rambouillet, Romnelet and Canadian Corriedale maximum fleece weight was attained in the second year of production and was maintained until the end of the fourth year, after which a significant decline began which continued until the end of the seventh year. Fahmy and Bernard (8) also reached the same conclusion. Vesely *et al.* (24) found that the three-year-old ewes produced the highest amount of raw fleece, which was significantly more than two-year-old ewes, but was not significantly different from the wool produced by four- and five-year old ewes. In another experiment (25) with Rambouillet, Romnelet, Columbia, Targhee and Suffolk sheep, they reported that two- to four-year-old ewes produced similar amounts of wool under range conditions, then the production declined with an increase in age. Brown et *al.* (1) reported that the greasy and clean wool production of Merino ewes reached its maximum at 3.5 years, then declined by 0.2 to 0.3 pounds per year. They also estimated that the main factor for the increase in wool weight from 1.5 to 3.5 years was the increase in total number of fibers and the subsequent fall was mainly due to the decrease in fiber volume, with a minor contribution from total fiber number after 6.5 years. A significant effect of age on wool production is also reported by Ray and Sidwell (17) and Thrift and Whiteman (22).

Some small changes appeared in the ranking order of the different age groups as the moisture content of wool was adjusted on a 12 percent basis (Table 3). The moisture content of the yearling ewe fleece was significantly less than that of the other age groups which did not differ significantly. Consequently, the amount of moisture-adjusted wool of yearling was increased and did not differ significantly from that of two- and three-year-old ewes. There was no significant difference between the moisture-adjusted semi-washed wool production of two- to five-year old ewes.

Age of ewe had a highly significant effect on percent yield. Four-year-old ewes had the highest percent yield as compared with the other age groups, which were similar, and showed no regular association with age. There are contrasting reports on the effect of age on percent yield in the literature. Vesely, *et al.* (24, 25) reported that age had a significant effect on percent yield, declining with increase in age of ewe from two to seven years. Brown *et al.* (1) found that percent yield increased up to 3.5 years of age and did not decline until after 6.5 years.

Year of Production: Year effect was highly significant for all the traits studied (Table 2). Year of production accounted for 3.72, 9.70 and 0.28 percent of the total variation of semi-washed fleece weight, percent yield and clean fleece weight respectively. Semi-washed fleece weight, moisture-adjusted semi-washed fleece weight and clean fleece weight were significantly higher in 1973, but percent yield and moisture percent was significantly higher in 1974 as compared with the previous production year (Table 3).

Some Aspects of Selection for Increased Wool Production: Clean fleece weight is recognized to be the most effective single characteristic on which selection for increasing wool production can be based, as it is the most accurate measure of an animal's wool production ability. When clean fleece weight can be obtained, it should be used in selection programs, but greasy fleece weight can also be used as a reasonably reliable indicator of clean wool production. If the animals are washed prior to shearing, semi-washed fleece weight would be a more reliable estimate of the production ability of the animal than greasy fleece weight. The high percent yield obtained as a result of washing the animals prior to shearing and the high correlation between moisture-adjusted semi-washed fleece weight and moisture-adjusted clean fleece weight (Table 4), support the above argument. The amount of clean fleece weight was increased by 0.71 kg to 0.95 kg for each kilogram increase in semi-washed fleece weight for different breeds. The correlation coefficients between these two traits were all high, positive and highly significant for all of the five breeds, ranging between 0.88 and 0.95. These estimates were much higher than those reported by Ragab and Ghoneim (16) for Egyptian carpet-wool Barki sheep (-.02 for 6 months old and -.0.09 for 12 months old), and were higher than estimates of the correlation between greasy and clean fleece weight reported for apparel wool breeds (2, 20, 23).

Quantitative improvement of wool through selection is limited because only part of the observed variation between animals is due to heritable differences. Many non-genetic or environmental factors are known to influence wool production. Knowledge of these factors, the amount of their contribution to the observed variation, and appropriate adjustments for their respective effects, will contribute to the accuracy of observation and therefore the efficiency of selection.

Although the contribution of age of the animal and production year to the total variation in wool production is low, nevertheless, due to their significant effects, records should be adjusted for their effects selection is usually based on within-year production records of a specific age group at the early stages of the animals' life, usually after the first shearing.

When groups of ewes with different ages are purchased for establishing a foundation flock or when cutting of a high proportion of a flock is required, the adjustments of wool production for age should be considered. Because the analysis of the data showed a curvilinear relationship between age of the animal and wool production, the data each of the production year-breed subgroups were fitted to a parabolic function. Then the data within each subgroup were adjusted for the effects of age of the animals using the appropriate parabolic functions. The original data on semi-washed fleece weight for each production year-breed subclass were plotted against age of the animals and are shown in Figure 1.

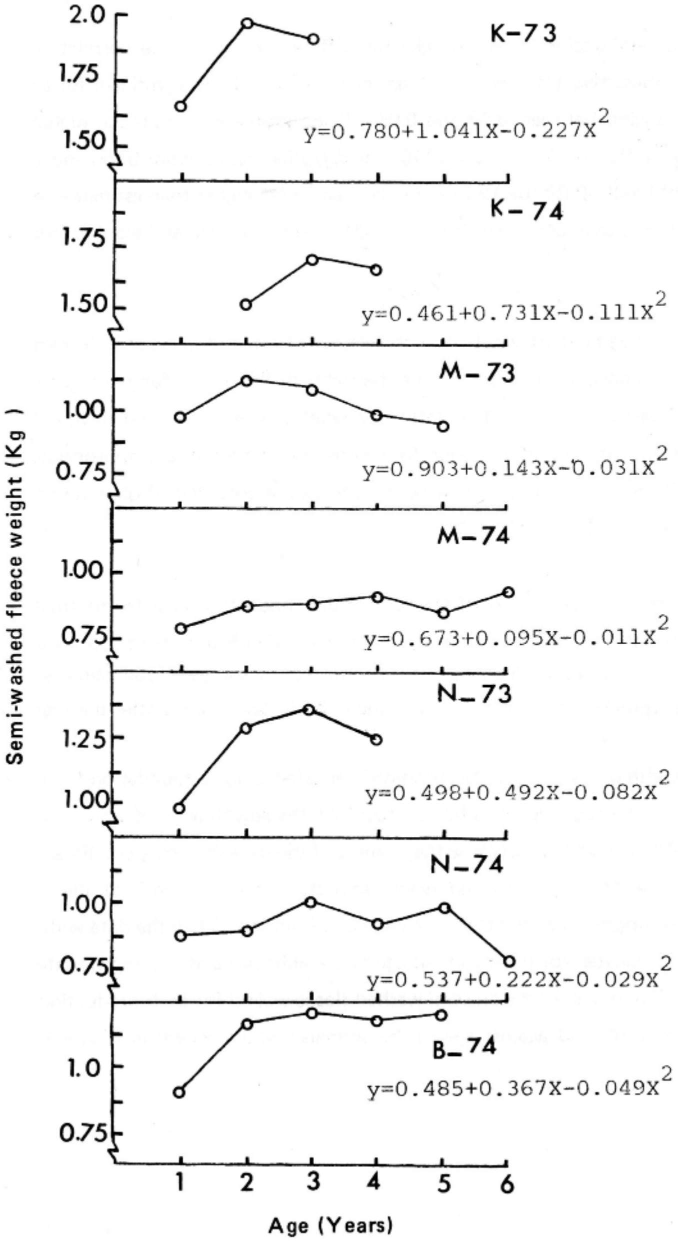

Fig. 1. Semi-washed wool production in relation to age of ewes in different breed-year subclasses and the appropriate equations (K=Karakul, M=Mehraban. N=Naeini and B=Bakhtiari)

The appropriate function for each set of data is also shown. Considering the different equations, it can be concluded that due to the high variation in the coefficients of the independent variable (age), developing a unique function for adjustment of age effect applicable to all the breeds in different years, or at least to each breed in different years is not practical.

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