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STUDIES ON THE RELATIONSHIP BETWEEN THE CRIMPS/INCH, DIAMETER AND THE STAPLE LENGTH OF CROSSBRED KAGHANI WOOL FIBRES FOR ASSESSING THE WOOL QUALITY

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Studies have been carried out on 20707 staples contained in 180 samples of crossbred Kaghani wool in order to determine a relationship between the crimps/in, diameter and staple length. Out of 20707 staples only 2567 staples showed an agreement with the standards of crimps and those of fibre fineness. It was found that the crimp frequency varied between 10--12 crimps/in and 1--2 crimps/in with mean diameters of 16.5μ and 45.2μ and mean staple length of 1.7 and 5.0 in respectively. The results were compared with American and English wool grades and A.S.T.M. standard for quality assessments.

Introduction

In estimating the value and suitability of wool for yarn manufacturing purposes crimps/in, diameter and staple length are the three most important characters to be considered.[1] Crimp in wool fibre is an important feature in processing and it may influence the handle and bulkiness of fabrics.

Crimps play a most important part in the visual estimation of wool quality and assessments of values in commercial transactions, partly because they are a guide to the estimation of fibre diameter, with finer fibres usually having more crimps per inch.[2] Visual assessment of wool quality of staple crimp frequency may, however, in some instances, lead to considerable errors.[3–6].

Uniformity of crimp has also been taken as indicating uniformity in diameter, although this point is still disputed.[7,8] It appears that the influence of crimp on processing has been over-emphasised.[9–12]

Subjective assessments of raw wool are largely influenced by staple crimp and by softness of handle, both of which are related to mean fibre fineness. The spinning performance of tops and the properties of yarns are largely determined by fibre fineness and to some degree fibre length; the latter being important when spinning near the "limiting yarn count". It was observed[13] that wools with fewer crimps per inch spun near the limit on the "ambler super draft" have "fewer ends down" than those with higher crimps per inch, but the reverse was the case when a conventional system was used. There are other properties which are important in cloth finishing. These could be well associated with crimp type since there is evidence that the ratio of ortho to paracortex, as well as the fibre fineness, influences the crimp.

The relationship between fibre fineness and crimps depends upon the individual breed, the geographic location of the sheep, their age and the part of the fleece from which the wool is derived.[13]

A general study of crimps per inch, diameter and staple length has been undertaken on the well-defined staples of 180 samples of crossbred Kaghani wool (Rambouillet × indigenous Kaghani breed) collected in July 1967. Results of these measurements were compared with the American, English wool grades and also with A.S.T.M. standards quality designation.

Materials and Methods

Out of 180 samples of crossbred Kaghani wool 20,707 staples have been observed. Selection has been made of only 2570 staples which have sound, well-grown and clearly defined crimp[15] while unevenly grown wool staples with ill-defined crimps have been discarded.

Crimps Measurements.—The crimps per inch were measured by counting the number of waves corresponding to one inch on a scale placed alongside the staple. Measurements were taken at three different places along the length of the staple to get an average.

Diameter Measurements.—The staples after finding the crimps/in were treated with benzene and thereafter with ether to remove dirt and other impurities. These were then cut into small pieces and slides were made. The diameter was measured at × 500 magnification with a lanameter. Twenty to twenty-five readings were taken for each staple.

Length Measurements.—The length of the individual staples were measured against ordinary ruler under slight tension and the distance between the two ends were noted.

Results and Discussion

The production of woollen-worsted yarns in the country has increased from 1.14 million lb to over 20 million lb and for this, foreign wool in the form of tops is being imported for consumption in woollen mills within the country. In order to reduce this unfavourable drain on foreign exchange, importations of foreign fine wool breeds for crossbreeding with the indigenous breed have been made, resulting in an upgrading of the crossbred wool. In certain places of West Pakistan which have suitable climatic and pasture conditions fine wool has already been introduced as the result of crossbreeding. In Kaghan valley crossbreeding between the indigenous breed and the Rambouillet breed is in progress. For assessment of quality of the crossbred Kaghani wool a detailed study, on 2570 staples of 180 samples, has been made on the general fibre diameter, crimps per inch and staple length.

Table 1 shows the whole observation of staple crimps/in and diameter. When 2570 staples from a wide range of 20,707 staples of crossbred Kaghani wool has been examined for staple crimps/in and mean diameter and the result is shown in the table, it can be seen that for any one staple crimps groups, there is wide range of mean diameters. The diameter increases with decrease of crimps/in. The 12 crimps/in group staples mean diameter is 16.5μ though fibres with a range of diameters 14–23μ have been observed. Similarly in 11 crimps/in group, mean diameter is 20.4μ although fibres with a range of diameters of 18–41μ have been observed and so on.

Table 2 shows a comparison of crimps/in and diameters of crossbred Kaghani wool with A.T.S.M. grade designation. Eleven to twelve crimps/in group diameter ranges between 16.5–20μ which exists in the A.S.T.M. standard limits for average fibre diameter of 17.7–19.4μ which has a grade of 80's, therefore, 11–12 crimps/in group could be included in the above grade. Similarly all crimps groups, i.e. from 11–12 crimps/in to 1–2 crimps/in with mean diameter of 16.5–45.2μ could be catagorised with respect to A.S.T.M. standard specifications. The whole observation indicates that crossbred Kaghni

TABLE 1.—NUMBER OF STAPLES FALLING IN DIFFERENT CRIMPS GROUPS AND THEIR DIAMETERS.

Mean diameter (μ)	Crimps per inch											
	12	11	10	9	8	7	6	5	4	3	2	1
10 13	—	—	—	—	—	3	2	3	24	20	26	
14 17	3	—	—	5	3	10	5	5	26	15	17	
18 21	1	2	2	3	6	8	20	40	50	8	28	
22 25	1	1	6	10	18	45	75	55	38	33	10	
26 29	1	3	4	8	12	25	84	68	52	50	37	
30 33	2	2	8	13	18	27	32	58	42	32	29	
34 37	—	5	6	11	15	22	25	42	56	62	20	
38 41	—	6	10	22	25	29	33	38	78	55	28	
42 45	—	—	5	18	20	15	48	40	35	25	15	
46 49	—	—	6	12	14	22	35	46	25	15	8	
50 53	—	—	2	3	15	8	22	20	20	12	25	
54 57	—	—	12	15	10	5	20	12	28	—	—	
58 60	—	—	—	5	8	15	22	28	33	—	—	
Total staples	8	19	61	125	164	234	425	465	509	327	233	=2570
Mean diameter	16.5	20.0	20.5	22.5	25.3	27.5	32.0	34.2	38.8	40.6	45.2	

TABLE 2.—CRIMPS PER INCH, MEAN DIAMETER, TOTAL STAPLES AND STANDARD DEVIATION OF CROSSBRED KAGHANI WOOL AND COMPARISON WITH A.S.T.M. QUALITY DESIGNATION.

Crimps/in	Mean μ	Total staples	A.S.T.M. standards			Standard deviation of mean dia
			Grade	Limit for average fibre dia	Limit for standard deviation	
11–12	16.5–20.0	27	80's	17.60–19.4	4.09	5.39
9–10	20.5–22.5	186	70's	19.15–20.5	4.59	3.18
7–8	25.3–27.5	398	56's	26.40–27.8	7.59	8.85
5–6	32.0–34.2	890	46's	32.70–34.39	9.59	9.96
3–4	38.8–40.6	936	36's	38.10–40.20	11.19	11.85
1–2	40.2–above	233	Coarser than 36's	Above 40.20	—	—

TABLE 3.—ASSESSMENT OF GRADES OF CROSSBRED KAGHANI WOOL IN CRIMPS/IN, DIAMETER BASES AND COMPARISON WITH AMERICAN AND ENGLISH WOOL GRADES.

American grades			English grades			Quality numbers of crossbred Kaghani wool			
Grades	Crimps/in	Dia/μ	Grades	Crimps/in	Dia/μ	Assessed on crimps/in		Assessed on fineness	
Very fine	22–30	18.1 22.5	80s 70s	18.20 16.18	18.1–19.5 19.5–21.0	—	—	16.5–20.0 20.5–22.5	80s 70s
Fine	14–22	26.6 24.0	64s 62s	14.16 12.14	21.6–22.5 26.6–24.0	—	—	—	—
blood	10–14	24.1–25.5	60s	10.12	24.1–25.5	11–12	60	—	—
3/8 blood	8–10	25.6–27.0	58s	8.9	25.6–27.0	9–10	58	25.3–27.5	58s
blood	5–8	27.1–29.0	56s	6.7	27.0–29.0	7–8	56	—	—
Low quality	2–5	29.1–31.5	50s	4.5	29.1–31.5	5–6	50	—	—
Common	0–2	31.6–34.7	48s 46s	3.4	31.6–34.7	3–4	48 46	32.0–34.2	48s 46s
Breed	0–1	34.8–41.3	44s 40s	2.3	38.8	1–2	44	38.8–40.6	40s 36s
			36s 32s	1.2	—	—	—	45.2	Coarse/ than 36s.
			28s	1.0	41.3	—	—	and above	

wool could be included in the range of 80's to 36's grades with respect to A.S.T.M. standards.

Table 3 shows assessments of grades of crossbred Kaghani wool on crimps/in and diameter bases and comparison with American and English wool grades.

When quality assessment is based on crimps/in, we get a range of 60's to 44's grades for 11–12 to 1–2 crimps/in, but when it is based on diameter, we get a range of 80's to coarser than 36's grades for 16.5μ to coarser than 45.2μ diameters range of crossbred Kaghani wool.

All the above observations show that crossbred Kaghani wool has a range of 11–12 crimps/in to 1–2 crimps/in with a range of 16.5–45.2μ (Fig. 1) and above. For each staple crimps groups there is no specific range of mean diameter, but there is a wide range of mean diameter, therefore, it can be seen that it is not correct to rely on staple crimp too far in deducing the mean diameter,[16] because there are too many exceptions.

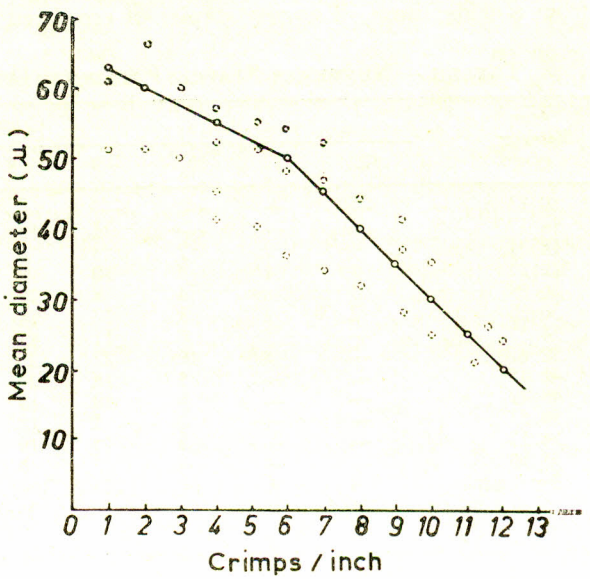

Fig. 1.—Showing the relationthip between crimps/inch and mean diameter in microns.

When compared with A.S.T.M. standards on diameter bases, the crossbred Kaghani wool has a range of 80's to over 36's. Similarly with American and English wool grades on diameter bases, the above range of grades have been observed, but when compared on crimps per inch bases, coarser grade than 80's i.e. 60's for the same range of crimps/in i.e. 11–12 crimps/in have been observed. Correct assessment of grades, therefore, of crossbred Kaghani wool with A.S.T.M. standards and English wool grades could be reliable when it is based on diameter, rather than crimps/in.

To produce different kinds of woollen and worsted yarn and to get the desired effect on the finished products, wool of uniform "character" and a specified fineness or grade is required. It is obvious that a fine lightweight fabric could not be produced from a coarse wool, nor would a fine wool be used to produce a rough cloth.

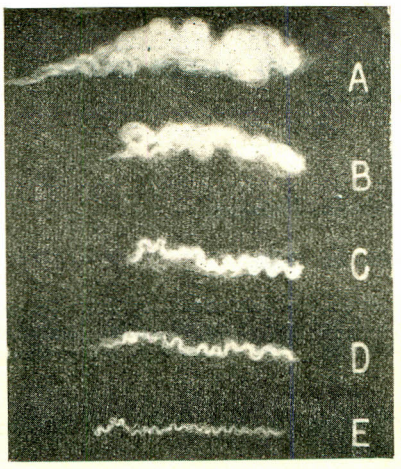

Plate 1.—Showing various crimps/in in staples of crossbred Kaghani wool. A=2–3 crimps/in; B=4–6 crimps/in; C=6–8 crimps/in; D=8–10 crimps/in; E=10–12 crimps/in.

Crossbred Kaghani wool[17] under observation has mostly true fibres, but includes also some heterotypical and little or no medullated fibres, with a mean diameter range of 16.5–45.2μ and a good staple. This breed has on the average a higher number of crimps/in (plate 1) than other types of Pakistani wool, which have little or no crimps. It has the additional characteristics such as good strength, elasticity[18] and resilience which are considered desirable for the production of good quality yarn. The largest number of samples of crossbred Kaghani wool of 56, 46, and 36 are deducted as shown in the Table 2. The yarn produced from the above type of wool could be utilised in manufacturing tweeds, skirting, ladies overcoating and similar other types of wool goods.

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