

Spinnability of Rambouillet, Chokla, Their Crossbred and Corriedale Sheep Wools

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The spinnabilities of Rambouillet(R), Chokla(C), $R \times C (\frac{1}{4})$, $R \times C (5/8)$, $R \times C (\frac{3}{4})$ and Corriedale sheep wool have been assessed. It is observed that a yarn having 40-50 fibres per cross-section can be spun economically and conveniently out of these wools.

Conventionally, wools are designated by their quality numbers such as 64s, 58s, etc., which indicate the spinning capacity of the designated wool in terms of the number of hanks spun (each of 560 yards) from one pound of wool. However, this relationship no longer holds good and is a fancy of Bradford system of worsted spinning^{1,2}.

The most important factor contributing to spinnability is fibre fineness, which, in turn, determines the number of fibres in the average yarn cross-section and the number of ends down per thousand spindle hour. The other factors which could contribute to spinnability are fibre length, fibre strength, softness, medullation, etc. Stanbury³ and Bastawisy *et al.*⁴ have shown that the finest count that can be spun from a wool on Bradford system usually has 20-24 fibres in its average yarn cross-section, but the number of ends down per thousand spindle hour observed was two thousand, which is very high for commercial production. Bergen and Wakelin⁵ conducted spinnability trials on French worsted spinning system and concluded that yarns of acceptable quality can be spun commercially with approximately 40 fibres in its cross-section with reasonable number of ends down per thousand spindle hours (approx. 100). This was confirmed by Onions⁶, and Stanbury and Byerley².

No such study has been conducted on Indian wools, specially on crossbreds. In the present study, the spinnabilities of some Indian crossbred wools have been assessed.

Materials and Methods

The following wools of April 1974 clip were taken from the sheep flocks being maintained at the institute and its substation at Mannavanur: Rambouillet, $R \times C (\frac{1}{4})$, $R \times C (5/8)$, $R \times C (\frac{3}{4})$, Chokla, and Corriedale.

The experimental wools (each lot of 30 kg) were dusted, scoured and carded under normal standard

settings on a worsted Torigoe Japan make card. The carded material was processed through an autoleveller gill before and after combing (all Japanese machinery). The gilled material was processed through super-drafter and super-bobbler employing suitable drafts and doublings and were taken to ring spinning from where appropriate yarn numbers were spun. The drafts in all cases were kept same up to the super-drafter stage and the required adjustments of draft were made only at super-bobbler and ring frame in order to obtain the desired yarn number, depending upon the hank of super-drafter sliver. Spinning was carried out on 8 spindles for 20 hr for each count and the end breakage per thousand spindle hour was calculated. The specifications of the Torigoe make Japanese ring frame are as follows: Bobbin lift, 14 in; ring diameter, 4.5 in; revolution/min, 2500; drafting system, Nittoh Pat NK 80 Japan; draft range, 2.5-16; twist range, 135-722.4 T.P.M.; and number of spindles, 12.

Laboratory scouring yield⁷, grease content⁷, vegetable matter content⁸, fibre length⁹, diameter¹⁰ and medullation¹¹ were estimated according to standard procedures. Staple crimp/cm was observed manually. The number of crimps over the full length of staple was observed and crimp/cm was obtained by dividing the number of crimps by the staple length.

Ten skeins of 100 m were prepared and weighed on "Sauter" monopan balance (accuracy, 0.01 g). From the skein weight, metric yarn number was obtained by dividing the length by weight.

The yarn breaking strength and percentage elongation at break were determined using the Uster automatic single yarn strength tester as per standard procedures¹² so as to break the yarn within 20 ± 3 sec. Evenness of the yarn and imperfections were observed on Uster evenness tester. Rank was given according to Uster standard norms prescribed in Uster manual. The number of fibres per yarn cross-section was

determined by manual counting. From an equal distance of about 5 m, a cut of 0.5 cm of yarn was made with the help of a sharp razor blade. The cut yarn obtained was placed on a black velvet board, untwisted and each fibre was counted with the help of a telecounter. From each yarn, 25 observations were taken and averaged out. All the above tests were performed at $27 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ RH.

Results and Discussion

Data on scoured yield, vegetable matter content, grease content (in raw and scoured samples) and crimp for the six experimental wools in the raw state are given in Table 1. The fibre attributes at the raw and combing stages of processing are given in Table 2. Yarn test results in respect of number of end-breakages per thousand spindle hour, Uster CV%, imperfections, tenacity, elongation at break and average number of fibres per yarn cross-section are presented in Table 3.

The test results in respect of scoured yield, vegetable matter content and grease content are presented for the sake of information. Data which bear more influence on the spinnability like fibre diameter, number of fibres per yarn cross-section, etc. are discussed.

The values of crimp frequency per cm (Table 1) indicate that it increases with increase in fineness,

except in the case of Corriedale wool where the crimp is more or less equal to that of Chokla, although the wool is comparatively much finer. This low crimp in Corriedale wool indicates that it is not essential that fineness is always accompanied by crimp frequency in similar proportion.

Crossbred wools are comparatively much finer than pure bred Chokla wool (Table 2). Chokla is of 44's quality, whereas $R \times C$ ($\frac{1}{4}$) is of 58's quality. The higher crosses have further gained in fibre fineness, but the gain is comparatively small. Corriedale wool lies between $R \times C$ ($\frac{1}{4}$) and $R \times C$ ($\frac{5}{8}$) and is closer to the former. $R \times C$ ($\frac{3}{4}$) approaches nearer enough to Rambouillet. The variability of fibre diameter is less in crossbred wools than in Chokla wool. It is maximum (40%) in the case of Chokla and is about 31% for $R \times C$ ($\frac{3}{4}$). The variability is low for exotic wools (31% for Rambouillet and 26% for Corriedale).

The value of average fibre fineness improves for the wools in tops than the raw wool (Table 2). This may be because of the preferential loss of coarse fibres during carding and drawing operations. The change is maximum in the case of Chokla, since this wool contained a maximum of medullated fibres which being coarse, poor in scale and crimp, tend to break off and fall off, resulting in greater proportionate loss of

Table 1—Scoured Yield, Vegetable Matter, Grease Content and Crimp of the Experimental Wools in the Raw State

Wool	Scoured yield %	Vegetable matter content %	Grease content		Crimp/cm
			Raw %	Scoured %	
Rambouillet	46.7	7.86	10.29	0.42	4.97
Ramb. $\times$ Chokla ($\frac{1}{4}$)	46.5	4.63	4.92	0.42	3.01
Ramb. $\times$ Chokla ($\frac{5}{8}$)	50.2	7.63	5.93	0.34	3.05
Ramb. $\times$ Chokla ($\frac{3}{4}$)	55.5	11.45	7.62	0.33	3.59
Chokla	45.8	3.79	4.56	1.09	2.29
Corriedale	45.7	3.80	10.59	0.54	2.33

Table 2—Fibre Length, Diameter and Medullation in the Raw Wool, Tops and Noils of the Six Wools

Wool	Raw wool			Tops			Noils		
	Length mm	Diameter μ	Medullation %	Length mm	Diameter μ	Medullation %	Length mm	Diameter μ	Medullation %
Rambouillet	62.3 $\pm$ 0.9 (25.6)	19.3 $\pm$ 0.3 (30.8)	0.2	52.2 $\pm$ 0.9 (30.5)	19.0 $\pm$ 0.2 (29.1)	nil	24.3 $\pm$ 0.7 (47.3)	17.9 $\pm$ 0.2 (27.1)	nil
Ramb. $\times$ Chokla ($\frac{1}{4}$)	87.0 $\pm$ 1.8 (31.3)	24.6 $\pm$ 0.5 (40.8)	11.8	66.7 $\pm$ 1.3 (34.9)	24.7 $\pm$ 0.5 (39.1)	13.7	32.5 $\pm$ 1.1 (44.2)	20.5 $\pm$ 0.3 (39.7)	4.9
Ramb. $\times$ Chokla ($\frac{5}{8}$)	63.2 $\pm$ 1.2 (32.4)	21.3 $\pm$ 0.3 (30.7)	5.8	57.1 $\pm$ 1.1 (32.8)	21.4 $\pm$ 0.3 (34.6)	4.2	26.6 $\pm$ 0.7 (45.4)	19.5 $\pm$ 0.3 (26.3)	2.3
Ramb. $\times$ Chokla ($\frac{3}{4}$)	60.3 $\pm$ 0.7 (22.6)	20.7 $\pm$ 0.3 (31.4)	0.3	60.1 $\pm$ 1.2 (24.9)	19.3 $\pm$ 0.3 (31.3)	nil	24.8 $\pm$ 0.6 (39.3)	18.5 $\pm$ 0.3 (30.7)	nil
Chokla	112.7 $\pm$ 2.2 (33.9)	35.9 $\pm$ 0.7 (40.0)	35.9	100.5 $\pm$ 1.9 (32.1)	31.1 $\pm$ 0.6 (40.3)	24.8	33.5 $\pm$ 2.0 (65.4)	28.3 $\pm$ 0.5 (42.3)	17.9
Corriedale	113.2 $\pm$ 1.7 (26.5)	23.1 $\pm$ 0.3 (25.7)	0.8	95.7 $\pm$ 1.5 (27.2)	22.7 $\pm$ 0.3 (29.2)	nil	33.9 $\pm$ 1.2 (51.5)	20.5 $\pm$ 0.3 (28.1)	nil

Figures in parenthesis show CV%

Table 3—Number of End-Breaks, Uster CV%, Imperfections, Rank, Tenacity, Elongation at Break and Average Number of Fibres Per Yarn Cross-Section of the Different Yarns Spun from the Experimental Wools

Wool	Actual yarn number (metric)	Number of end-breakages per 1000 spindle hr	Uster CV %	Thin places	Thick places	Neps	Rank	Tenacity g/tex	Elongation at break %	Av. number of fibres per yarn cross-section
Rambouillet	31.7	nil	22.9	64	56	49	Average	5.37	8.8	57
	40.5	62	24.0	80	60	55	do	5.07	8.5	50
	50.0	125	26.8	92	70	58	Uneven	4.48	8.0	43
Ramb. $\times$ Chokla ($\frac{1}{2}$)	34.9	125	24.6	69	43	42	Average	4.05	8.1	49
	40.2	187	26.6	95	54	50	do	3.58	6.4	42
	44.6	251	27.5	99	60	57	Uneven	3.05	6.0	37
Ramb. $\times$ Chokla ($\frac{5}{8}$)	30.8	62	23.9	54	44	40	Average	5.10	8.8	57
	38.3	62	24.8	68	52	48	do	4.09	7.3	51
	45.0	250	27.1	72	58	46	Uneven	3.72	6.8	42
Ramb. $\times$ Chokla ($\frac{3}{4}$)	34.0	nil	23.2	59	47	38	Average	4.49	10.7	55
	39.9	125	24.7	66	54	52	do	4.86	9.6	51
	49.0	312	26.8	81	62	57	Uneven	4.22	7.9	43
Chokla	20.3	62	20.7	41	22	21	Average	6.53	11.3	41
	23.3	125	21.4	53	26	17	do	6.16	11.9	31
	27.0	187	24.0	70	36	25	Uneven	5.34	10.5	26
Corriedale	36.1	nil	19.7	38	19	15	Average	6.35	8.4	50
	47.3	62	22.6	88	36	21	do	5.48	7.8	42
	52.0	125	26.9	94	40	24	Uneven	4.95	6.9	37

such fibres. The variability of average fibre diameter in the case of Chokla and $R \times C$ ($\frac{1}{2}$) also falls, which further confirms the preferential loss of such coarse fibres. This effect is not so significant in the case of other wools which contained comparatively less or practically negligible medullated fibres and thus the change in the average value of fibre fineness is less.

Fibre length values show that in crossbreds, the mean fibre length is comparatively less. It is considerably low in the case of $R \times C$ ($\frac{1}{2}$) wool and still less in $R \times C$ ($\frac{5}{8}$) and $R \times C$ ($\frac{3}{4}$) wools, approaching more or less nearer to that of Rambouillet. The variability follows the pattern of fibre fineness, i.e. CV% reduces with increasing blood level of Rambouillet. The average fibre length measured in tops is less than the average length in raw wool, which is due to the fibre breakage/loss during mechanical processing. The fibre entanglement due to excessive vegetable matter content also contributes to fibre breakage and length loss.

In the present investigation, the yarns have been spun from each wool in stages with a combination of drafts till the yarn is rated as average according to Uster norms and a stage further, with the combination of number of ends down to a limit of about 200 per thousand spindle hour.

Data in Table 3 reveal that only Chokla and Corriedale wools can be spun to the theoretically estimated yarn number having approximately 40 fibres per cross-section with average regularity as per Uster

specification. The rest of the four wool yarns come under average rating prior to their spinning limit, but spinning at the 40 fibre stage results in the production of uneven yarns. These yarns, which contained around 50 fibres per yarn cross-section and above, were found to be of acceptable regularity from Uster standards.

The data in Table 3 reveal that the spinning capacity for the wools in general reaches at approximately 40 fibres in their yarn cross-section. This confirms the findings of the earlier workers^{2,5,6}. In the case of Chokla and Corriedale, spinning was possible even up to the 30 fibres stage, which is mainly due to their superior fibre lengths. This further confirms the results of trials conducted by Bastawisy *et al.*⁴ that 10.4 cm long wool fibre spins 12 counts finer than 7.3 cm long wool fibre. In the present study too, Chokla and Corriedale wool fibres were 11.3 cm long as against 6-8 cm long fibres of the other four wools.

Conclusion

It is observed that generally a yarn having 40-50 fibres per cross-section can be spun economically and conveniently out of wools having 6-8 cm long fibres. Higher number yarns can be spun from long wools of about 10 cm having 30 fibres per cross-section.

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