Proceedings of the

4-7 july **2000** – Valencia Spain

These proceedings were printed as a special issue of WORLD RABBIT SCIENCE, the journal of the World Rabbit Science Association, Volume 8, supplement 1

ISSN reference of this on line version is 2308-1910
(ISSN for all the on-line versions of the proceedings of the successive World Rabbit Congresses)

Gupta N. P., Pokharna A. K., Shakyawar D. B., Singh R. N.

Status of Angora Wool Production and Utilisation in India

Volume B, pages 89-95

STATUS OF ANGORA WOOL PRODUCTION AND UTILISATION IN INDIA

GUPTA N. P., POKHARNA A. K., SHAKYAWAR D. B., SINGH R. N.

Central Sheep & Wool Research Institute
AVIKANAGAR, Via- Jaipur, 304501(India)

ABSTRACT

The Angora wool production has been initiated in India by introducing exotic German, British and Russian angora in the high altitude of subs Himalayan region. Since the performance of German angora from productivity and wool quality point is superior but lacks in productive efficiency, therefore, the crosses of German angora with British and Russian angora were also introduced. The wool quality collected from side region from 2-3 years animals were taken from quality evaluation in respect of physical and mechanical properties. The annual wool yield in German angora is found to be highest at 612 g while the other gave 300 to 427 g. The fineness of wool fibre ranged from 12-13 micron and the fibre length from 40-56 mm. However recently the length has increased to 55 to 62 mm. The tenacity of the fibre ranged from 13.0 to 14.84 g/tex and extension at break from 30 to 40.6. Angora wool in pure form is difficult to process however it can be blended with cotton, polyester staple, silk staple and fine wool for spinning yarn of upto 67 Nm. The optimum angora proportion in blend is found to be 50:50. Among different spinning system viz. woollen, worsted, cotton and friction spinning system, modified cotton spinning system and woollen khadi spinning system are found appropriate for production of quality products.

INTRODUCTION

Angora wool, the speciality fibre has special characteristics like excellent whiteness, superb softness and high warmth. The fineness of angora wool is quite comparable with well-established speciality rare fibre viz. Cashmere, vicuna, Alpaca, Shah, Tusk etc. The angora wool production and utilisation has increased over the year and, now, it is spreading the Asian countries. The fineness & lightness of angora wool makes it most appropriate to use for finer yarn spinning and lightweight material manufacturing. The blending of angora wool with other notable fibres viz. Cashmere, superfine merino, natural silk, cotton polyester, acrylic etc. with appropriate proportion makes the end products most attractive and increase the consumer demand. Considering the relative importance of angora wool, developmental policy was initiated in North Himalayan belt of India to introduce Angora for increasing speciality fibre production. Three major exotic genotypes viz. German, British and Russian were introduced as early as late 70^{S}. Moreover, their crosses of different blood levels have been developed for selecting the best genotypes adaptable in Indian environment and can give higher wool yield with internationally acceptable quality grade (MAHAJAN, 1984)). To increase market demand of such newly developed speciality wool, the work on suitable utilisation technique was also initiated. The existing set of cotton, woollen, worsted, friction spinning machinery and khadi spinning systems were evaluated for processing angora wool blends.

In the present paper, the physical & mechanical properties of different exotic and crossbred genotypes of angora wool have been reported. Moreover, an attempt has been made to select the appropriate fibre for blending with angora wool and also to select the suitable system of

machinery for processing angora wool blends and product development for optimum utilisation of the fibre.

MATERIAL AND METHODS

Three exotic breeds viz. German, Russian and British angora and three cross-breds viz. GA x RA, GA x BA and GA x BA x RA developed at NTRS, Garsa of CSWRI, were taken for the study. The performance of angora in respect of litter size at birth and weaning and weaning weight at birth, kit survival % were recorded.

The mid-side wool samples from the angora of 2-3 years of age of both sex were collected for quality evaluation. The total fleece of 2-3 year's animal were collected and sorted out to remove short and matted fibres. The clean, untangled wool was chosen for processing studies. Various natural and synthetic fibres viz. cotton, natural silk, sheep wool of finer quality, polyester, tencel and acrylic were taken up for blending.

RESULTS AND DISCUSSION

1 Wool Production

The purebred German, British and Russian angoras were tested under Indian situation at N.T.R.S. Garsa of CSWRI. Various crossbred were also developed in order to study their reproductive performance and fibre production which is shown in Table 1. German Angora has the highest yield for all the clips followed by other crosses. The lowest wool yield is observed in Russian Angora. The German Angora sire breed increased the wool production and improved the survivability and reproduction of crossbred. The three-breed cross of German Angora with Russian Angora and British Angora as well as two-breed crosses of German Angora produced similar wool quantity. German Angora is known for their hardiness, better viability and reproduction (LALL *et al*, 1984).

Table 1 Reproductive Performance and Wool Production of Different Exotic and Crossbred Angora

ATRIBUTES	GA	RA	BA	GAxRA	GAxBA	GAxBAxRA
Litter size at birth (No.)	5.55	6.21	5.44	6.09	5.56	5.00
Litter size at Weaning	4.86	5.86	5.22	5.64	4.00	4.36
Litter size at birth(kg)	0.242	0.301	0.270	0.285	0.250	0.241
Individual (Wt. at weaning)(kg)	0.524	0.559	0.598	0.619	0.622	0.677
Kit survival (%)	87.54	94.25	95.00	92.54	71.19	87.17
Annual Wool Yield (g)	**612.4**	**307.4**	**378.5**	**436.5**	**392.1**	**426.6**

GA - German Angora, RA - Russian Angora, BA - British Angora

The state of Himachal Pradesh in India is presently the largest producer of Angora Wool 20 ton which has a population of nearly 30 000 animals spread over 250 units (ANON., 1997). The state of Uttar Pradesh introduced in the year 1984-85, Angora breeding programme in the hilly areas and has a population of nearly 10 000 which produced 6 ton (MUTTU, 1996). The main breeds available with the farmers are German, British and Russian Angora wool. Besides above states, angora rearing programmes have been launched in the state of Sikkam, Darajeeling region of West Bengal and North Eastern region of the country with active help from Unites Nations Development Programme (UNDP). The Central Wool Development Board of Govt. of India has taken up a project for development of Angora in the country and is sponsoring training programs for farmers/ breeders as well as arranging distribution of germ-plasm (NEGI, 1990).

2 Angora Wool Quality

The angora wool obtained from different genetic groups reared under NTRS, Garsa, Himachal Pradesh were evaluated in respect of fibre physical and mechanical properties. The results of physical properties are shown in Table 2. It shows that the fineness and staple length at introducing time (80s) was in between 11-13 µm and 41-55 mm respectively. After stabilizing these strain in Indian environmental conditions, the range of diameter becomes slighter coarser (12.5-13.2 µm) and the range of staple length is increased to 54 – 64 mm. Among different genotypes, the cross of German and Russian Angora was found to be finer and longer staple length.

Table 2 Fibre Characteristics and mechanical properties of different Angora Wool

Genotype (see table 1)	**Fibre fineness µm**		**Fibre length mm**		**Medullation %**	**Tex**	**Tenacity (g/tex)**	**Extension (%)**	**Young's modulus**
	Early 80s	At present	Early 80s	At present					
GA	13.48	12.55	41.3	54.9	2.62	0.18	14.84	39.74	15.54
BA	11.80	13.20	45.5	61.5	3.12	0.15	13.12	40.14	12.74
RA	11.77	12.75	48.9	56.9	2.88	0.23	14.89	39.20	17.23
G x B	11.56	12.73	42.2	60.3	2.89	0.21	14.72	40.63	14.74
G x R	12.45	12.59	52.5	62.1	2.60	0.17	13.21	38.77	13.81
G x (R x B)	11.64	12.68	55.7	61.9	2.70	0.14	14.00	36.20	16.21

The mechanical properties in terms of tenacity (g/tex), extension (%) and modulus of different angora wool are shown in Table 2. It is observed that the tex of Russian angora wool is high (0.228) as compared to that of wool of other genetic group (0.140-0.209). However, not much difference is observed in tenacity and extension at break. Further it is observed that Young's modulus is significantly higher in Russian Angora wool (GUPTA *et al.*, 1989).

3 Angora Wool Utilization

The angora wool is primarily produced in Himachal Pradesh is marketed by private traders and H.P. State wool marketing federation. This fibre is mainly utilised by Khadi institutions, non-governmental organisation and shawl & knitwear manufacturers. The modified cotton spinning system and worsted system is generally employed for making the yarns in the organised sector. In the decentralised sector the blends are either hand carded or machine carded and thereafter yarn is spun on various types of Charkha (hand spinning). Several problems are encountered during processing due to static charge, shedding tendency, differential dye uptake etc. In order to

3.1 Processing on Woollen system

Table 3 Characteristics of pure wool and Angora wool blended yarns and fabrics

	Parameter	Pure wool	Angora wool **:** sheep wool
Yarn	Yarn count (tex)	135	1.59
	Tenacity (g/tex)	4.35	4.95
	Extension (%)	29.4	21.6
Fabric	Strength : Warp	31.5	44.4
	Strength : Weft	25.9	26.4
	Abrasion loss	7.8	8.6
	Flexural rigidity	277	267
	Relaxation shrinkage Warp	1.80	3.05
	Relaxation shrinkage Weft	6.13	4.30
	Visual assessment	II	I

Angora wool and Avivastra wool were blended in the ratio of 25:75 for processing on woollen system (SHING *et al*., 1983; ARORA *et al*, 1993). The blend was opened by passing it through a willowing machine. The water-oil emulsion was sprinkled evenly over it. The material stored overnight, was willowed again and carded on Japanese Torigoe make

machine. A yarn of about 150 tex was spun with 224 twist per meter on the same make of machinery. Shawls were woven on a 90-inch wide Hattersley power loom keeping the ends and picks as 64 and 56 per dm respectively. The shawls were given standard finishing treatment of washing, softening, stentering and decatizing.

The Avivastra sheep wool and Angora wool blended woollen yarn properties reveal that blended yarn is more tenacious than pure wool yarn mainly due to the comparatively higher number of fibres per yarn cross-section which contribute towards higher strength.

The fabric characteristics reveal that the ends and picks in the two finished shawls are similar i.e. 80 and 60 per dm respectively. This shows that the shrinkage behaviour of the blended and pure wool shawls did not differ. The slightly higher weight of the blended shawl is due to the little coarse count of the blended yarn. The strip strength of the blended fabric is higher due to the higher strength of the blended yarn. There is little difference between the flexural rigidity values of the two fabrics. The slightly lower rigidity of blended shawls is due to less stiffness in the Angora wool fibre. The blended fabric could resist more number of abrasion cycles due to the higher number of fibres per yarn cross section and higher strengths of yarn and fabric. The abrasion loss was 13.3×10^{-3} and 10.5×10^{-3} g per cycle in pure wool and blended samples respectively.

The scouring shrinkage of the fabrics is observed to be 14.3%. This high shrinkage may be due to the multidirectional shrinkage of yarn in the fabric while scouring. Since woollen yarn has got fibres lying randomly in its body, the fibres get multidirectional opportunity to shrink. The decatizing treatment has also led to some shrinkage (1.8%) in the fabrics. This is due to the steaming and cooling action of the super-moist heated stream on the judiciously wrapped fabric in the decatizing machine. On visual assessment, all the judges unanimously ranked Angora wool blended shawl superior to pure wool shawl in respect of softness, whiteness, warmth and feel. Due to high number of protruding fibres in the Angora wool shawls, these were sensed to be softer, warmer and fuller.

3.2 Processing on Cotton System

For processing on cotton system of machinery, initial trials were conducted with processing on Shirley Miniature spinning machinery (GUPTA *et al.,* 1992)). The blend weighing 40g was prepared with polyester, acrylic, wool and cotton in the ratio of 50:50. The blends were thoroughly mixed manually and an emulsion of about 1% Nipcotex F (an antistatic agent) was sprinkled over it. After sprinkling, the material was again mixed thoroughly. Each blend was processed twice on carding and thrice on drawing to get uniform web and sliver. Yarns of 50 Nm was prepared from each blend keeping the same twist multiplier of about 120.

The polyester, acrylic, tassar and mulberry silk blended yarn reveal that the pure Angora wool yarn has the minimum tenacity of 5.4 g/text while tassar silk acrylic and polyester yarn have 8.4, 10.1 and 23.8 g/tex tenacity respectively. The tenacity of blended yarns is better than pure angora wool yarn, justifying its use in blends. In general, the polyester and mulberry silk blends seem to be better than the other blends. Moreover, 20% addition of Angora wool in acrylic and tassar silk has improved the yarn tenacity, further increase of Angora wool proportion reverses the trend.

The breaking elongation percent values have shown a reducing trend with increasing percentage of Angora wool content. However, a little increase in elongation values in seen at 20% addition of Angora wool. For example, for the blends with PET, with 20,40,60 and 80% of wool, the elongation at break values were found to be 12.6, 13.2, 11.8, 11.7 and 10.8% respectively. The same figures for blends with acrylic fibre were 16.2, 18.9, 16.1, 14.2 and 10.4% respectively and for tassar silk blends 12.7, 12.1, 11.1, 10.1 and 6.1 respectively. In general, all the blended yarn are found to be acceptable from spinning and weaving point view.

The blended yarn (50 PET:50 Angora wool) reveal that in a yarn with fairly good tenacity 14.9 g/tex and elongation value 10.2% could be produced on commercial cotton system of machinery. Obviously, the two plied yarns had still better results. The particulars of the two types of shawl fabrics reveals that the thickness of twill weave shawl is more than plain weave. This is due to the little higher number of ends and picks and the twill weave as compared to plain weave. The abrasion loss percent is higher in case of twill weave shawl fabric which may be due to higher floats in twill fabric. The breaking strength and elongation percent values do not show any different between the two types of shawls.

In another trial conducted on long staple cotton spinning system, Angora wool was blended with polyester, tencel and combed cotton in the proportion of 50:50 (PATNI *et al*., 1984). The fibres are blended at cotton carding machine and the sliver was given three passages of draw frame and then roving of appropriate linear density was prepared. The various blended yarns of 67 Nm were spun on cotton ring spinning system. The results of yarn quality are shown in Table 4.

Table 4 : Yarn Quality of different Angora Wool Blended Yarns Spun on Cotton Spinning System

Yarn (Blend ratio 50:50)	Yarn count Nm	Evenness U%	Tenacity g/tex	Elongation %
Angora: Polyester	67	16.2	16.5	9.84
Angora : tencel	67	13.2	7.9	4.52
Angora :: combed cotton	67	4.0	15.9	7.64

The results reveal that Angora polyester blended yarn gives highest tenacity and elongation than other blended yarns, however, it shows higher unevenness than Angora-tencel and Angora-cotton blended yarns. From evenness point of view, the Angora-tencel yarn is found more even than other two yarn. Moreover, Angora wool cotton blended yarn gives moderate tenacity as well as evenness which are quite acceptable for production weaving as well as knitting goods.

After above trials, an attempt was made to have a trial on commercial cotton set of machinery (LALL *et al*., 1984). Since blow room line in cotton system of machinery required a large quantity of raw material to be processed, it was considered more appropriate to open and card the blend on worsted system of machinery, wherein small quantity of material can be processed. For this purpose Torigoe willowing and carding machinery were utilised at CSWRI. A blend of Angora wool with polyester in equal proportion weighing about 10 kg was used. It was observed that neps are formed at the carding stage after the loading of the fibres takes place after its running for about half an hour. The carded sliver was further processed on cotton system of machinery at Aditya Mills, Kishangarh. The carded material was drawn twice at the drawing farm (Laxmi Rieter) and fed to simplex (Howa). The roving was drafted at the Textool ring-spinning frame having slip draft arrangement. The single yarn of 50 Nm was given 682.5 tpm. The plied yarn twist kept was 568 per metre. Two ply yarn was used on warp and single yarn as weft and shawls were woven on handloom. Two types of shawls of differing weaves were woven. The values of yarn breaking load, elongation and tenacity for the blends with wool and cotton reveal that a yarn with fairly good tenacity could be prepared from pure Angora wool. This shows that Angora wool has a good potential for spinning on the cotton system, provided a proper antistatic agent is used. The yarn tenacity increases with increase in cotton proportion. With a fine fibre like cotton, the yarn contains a larger number of fibres in its cross-section for a given yarn number, which implies more contact between the constituent fibres and less fibre slippage when a load is applied. The CV values of breaking load and elongation also indicate the superiority of the cotton blends over wool blends. The breaking elongation values of wool blended yarns are higher than those of cotton blended yarns.

3.3 Processing of Friction spinning system

Angora wool blends processed on woollen, Semi Worsted, Cotton, Worsted and Khadi spinning systems had very low production of 2 meters to 20 meters per minute (SHAKYARWAR *et al.,* 1997). To obtain higher productivity the Angora wool blends with acrylic staples were processed on Dref-2 friction spinning system at a speed 100-200 metres/minutes. The yarn properties of blended yarn spun on friction spinning system are shown in Table 5. The yarns were spun with polyester filament core, which adds to strength while to maintain the softness and fullness the angora wool-acrylic blend was kept on sheath. The yarn appearance was quite regular and suitable for the development of shawls and knitwears. The Angora wool: Acrylic (50:50 & 40:60) blended yarns of 10 Nm linear densities with filament core possess about 9.1 and 9.2 g/tex tenacity and 23 and 19.4% elongation, respectively which are much higher as compared to woollen, semi-worsted and other spun yarn.

Table 5 : Yarn quality characteristics of Angora wool-Acrylic blended friction spun yarns

Angora :Acrylic proportion	Tenacity (g/tex)	Elongation (%)	Tensile modulus (g/tex)	Uster CV%	Imperfections		
					Thin	Thick	Neps
50:50	9.2	23.0	39.8	16.5	0	2	233
40:60	9.1	47.0	47.0	16.8	11	1	133

CONCLUSION

The angora wool has special virtues and are costlier. The production of the fibre is hardly 30 000 kg annually which may not show much increase in near future. The demand of angora wool fluctuates considerably and supply in domestic market is influenced by liberal import. In the utilisation front, with limited production and availability of the angora wool, it is necessary to blend the angora wool with fine wool, natural silk, polyester and acrylic. Such blended products possess special virtues like softer feel, high warmth and these products are cheaper as compared to all angora wool products. The processing loss needs to be minimised with anti-static finishes. The migration and shedding of angora wool from the products needs to be controlled with suitable engineering of yarn structure. The utilisation of angora wool can be made in both organised and decentralised sector but latter is preferred as it creates rural employment. Moreover, the available quantity of angora wool is not sufficient enough to meet the requirement of organised sector. The combination of organised sector for angora blends yarn spinning and products manufacture on decentralised sector's handloom and hand knitting machines are advocated which serves the need of quality product manufacture with rural employment creation.

References

Anon, Angora Rabbit Husbandry in Himachal Pradesh, 7(4) 1997, 30-31.

Arora, R.K., Gupta N.P.; Patni, P.C. and Singh, U.S. " Performance of Angora hair Blends with Cotton and Wool Khadi System." *Indian J. of Tex. Res.* 1993, 8-127

Gupta, N.P., Arora, R.K. and Patni, P.C. "Properties and processing of Angora fibre". *The Indian Text. J*. April 1992, pp-75-72.

Gupta, N.P., Bapna, D.L.; Patni, P.C. and Mathur, J.P. "Stress-strain characteristics of Angora hair." *Indian J. of Text. Res.* Vol.24, Sept, 1989 pp 141-144.

Lall D, Vaid J & Negi S.S. " Angora Angoras for higher wool production". *The Farmer J*. July 1984 pp 50-52.

Mahajan, J.M. Indo-British workshop on Angora fur technology at Regional Research Laboratory, Srinagar 10-15 Oct., 1988.

Muttu S K, Brief Status paper on Angora wool, *Wool Ways,* 6(4) 1996, 1-18.

Negi J.P. "Marketing problems of Angora Wool" 1990. Paper presented at *Nation Seminar on Angora farming at CSIR Complex, Palampur*.

Patni, P.C.; Gupta, N.P. and Arora, R.K. " Performance of Angora hair blends on Cotton Machinery". *JTA* 1984, 45-208.

Shakyawar D B, Pokharna A K & Gupta N P, Proceessing of Animal fibres on Deref spinning system, *Text Industry & Trade J*, May-June, 1997, 27.

Singh, U.S., Arora, R.K., Patni, P.C. and Gupta, N.P. " Performance of Angora Hair- Wool Blend Shawls." *Indian J. of Tex. Res*. 1983, 8-125.