EFFECT OF JUTE CUTTING PERCENTAGE AND FLYER SPEED ON QUALITY RATIO AND END BREAKAGE OF JUTE YARN

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ABSTRACT

These studies were conducted in the Department of Fibre Technology, University of Agriculture, Faisalabad during 2001-2002. Various ratios of jute cutting (0, 10, 20 and 30 percent) were added in batch and its effect on jute yarn quality ratio and end breakage was recorded. Different flyer speeds (3400, 3600, 3800 and 4000 rpm) and yarn grists (9, 12 and 16 pounds) were also studied. The results showed that effect of cutting percentage and yarn grist on quality ratio was highly significant. However, effect of flyer speed and all interactions were non-significant. The highest and lowest values for cutting percentage were 82.83 and 71.19 at zero and 30 percent cutting, respectively. For flyer speed the highest and lowest values of quality ratio were 77.31 and 73.80 for 3600 and 4000 rpm, respectively. Similarly, yarn grist of 9 gave better quality ratio (87.93). The results for end breakage showed highly significant effect of flyer speed

KEYWORDS: Jute, quality; spinning; Pakistan.

INTRODUCTION

Internationally, jute is recognized as a valuable geo-textile fibre for bonding riverbanks, lining canals, etc. as a substitute of plastic. It also provides fabric for well furnished offices and homes. Jute has established its claim as popular choice in modern life. Many products from sophisticated curtains to designed carpets and wall decorations to soft luggage, contain its fibre. Besides Bangladesh and India the leading jute producers, it is also grown in Nepal, china, Thailand, Indonesia, Burma, Brazil, Vietnam, Cambodia and in some countries of Africa. Jute industry of Pakistan, based on imported raw material,

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not only meets the local demand of jute products but also produces surplus stock for export.

Three elements determine the cost of jute products viz. raw material, labour and energy. Raw material has the most significant role in a jute mills economy where price 56-70 percent of total conversion cost is associated with it. So relatively smaller increase in the of raw material has severe effects whole setup. About 40 percent of total jute production is of lower grade and cuttings, which should be used properly. Studies have shown that upto 70 percent cuttings can be used in sacking batches without any major problem and also upto 40 percent cuttings of white jute can be used in hessians. Stout (19) stated that greater the proportion of cuttings, the lower is the tenacity of yarn. Paul (15) stated that breaking tenacity of jute yarn decreases with the decrease in yarn grist.

End breakage is an important aspect of spinning quality of a textile fibre. Breakage rate is greatly affected by flyer speed and batch composition of material. Atkinson (4) noted that when frame speed was increased, more tension pulses arose and consequently more end-breaks occurred. For flyer speed from 3000-4500 rpm, yarn quality was lower and end breaks were higher and corresponding breaks per spindle were 2 to 4 per hour for 8 pounds (276 tex) jute yarn. The spinning breakage ratio varied widely from mill to mill, due to difference in quality, frame maintenance and tension levels. Mather (11) observed that an increase in card loading affected the spinning breakage rates. The level of moisture in jute has significant effects on processing and moisture regain of 30 percent proved as better for the processing machinery and techniques employed in these investigations (14).

MATERIALS AND METHODS

The present study was conducted in the Department of Fibre Technology, University of Agriculture, Faisalabad, during the year 2001-2002 in collaboration with M/S Habib Jute Mills Ltd. Juharabad, district Khushab.

The samples of raw jute were spun at apron drafting system simultaneously by selecting four levels of cuttings (C_O=0%, C_1=10%, C_2=2-% and C_3=30%) and flyer speeds (3400, 3600, 3800 and 4000 rpm). The jute yarn of three different grists (yarn size) viz. 9, 12 and 16 pounds was produced. The samples of Bangal long jute and cuttings were collected from the running material at Habib Jute Mills Ltd. and tested at the Research and Development Department of the Mills. The data for various quality characteristics both for raw jute and yarn were recorded by following methods.

Quality ratio

The quality ratio of yarn has been defined as its average breaking load in pounds divided by the value of grist multiplied by 100 (17). While the term 'girst' is used to denote jute yarn size and is defined as the weight in pounds of jute yarn of 14400 yards length. Mathematically the quality ratio is calculated as:

$$\text{Quality ratio} = \frac{\text{Strength (in pounds)}}{\text{Girst (in pounds)}} \times 100$$

The quality ratio is a convenient base for comparison of breaking loads and fibre quality of yarn commonly referred to as spinning quality.

End breakage rate

Yarn breakage has much importance because it is directly associated with the production out put of any yarn. After five minutes running of frame, counting was started to measure the number of end breakage rate for one hour as suggested by Lahiri (9).

Statistical analysis

Completely randomized design was applied in variance analysis for testing differences among quality characters studied in these investigations. Tests of significance were made at 5 percent level of probability. Duncan's new multiple range (DMR) test was also applied for individual comparison of means among various quality characteristics as suggested by Steel and Torrie (18) using M-Stat micro computer package devised by Freed (6).

RESULTS AND DISCUSSION

1. Quality ratio

The results (Table 1) indicated that effect of cutting percentage and grist is highly significant, while the effect of speed is non-significant. Also all the first and second order interactions remained non-significant. The data (Table 1b) further indicate that highest quality ratio (82.83) is recorded for C_0 followed by C_1 (76.53). It can be concluded that quality ratio deteriorates with the increase of cuttings. The results showed that quality ratio at C_0 and C_1 differ significantly from C_2 and C_3, while C_2 and C_3 recorded non-significant differences. Stout (19) verified the results that for a yarn of 275 tex, quality ratio ranged from 70 to 120, according to the grade of jute used. The results are also in accordance with Sarkar (17) who stated that sacking warps often have a quality ratio of 75 to 82. Similarly the results are in accordance with Mohi-ud-Din (12) who recorded 59.25 quality ratio for sacking weft 17 pounds yarn. However, present results slightly differ from Ranjan (16) who concluded that range of quality ratio for 8.25 pounds hessain warp by using 30 percent cuttings was 83.1 to 92.6. Similar views were given by Amin and Begum (3). This slight difference may be due to raw material used or improper blending. Abbas (1) reported that he had encountered no problem in 8 pounds hessain yarn with 40 percent cuttings of white jute. Hussain (8) stated that quality ratio for Pakistani jute was 73.66 percent, for Bangla White-B 90.64 percent and for Bangla Tossa-B (BTB) 99.85 percent.

In case of flyer speed, the highest quality ratio (77.31) was recorded at 3600 rpm followed by 3400 rpm (77.23) (Table 1b). However, the differences were non-significant indicating that flyer speed can be increased without sacrifying the quality ratio. Doraiswamy *et al.* (5) report similar findings with the conclusion that jute mills with flyer spinning produce relatively better quality as compared to the mils having ring spinning. The results significantly differ from previous study (7) which reported that increase in flyer speed decreases the quality ratio. Atkinson (4) pointed out that quality ratio for 8 pounds jute yarn on slip draft and apron draft spinning systems was 95 and 102 percent, respectively.

For yarn grist, the highest quality ratio (87.93) was observed for G_1 and lowest for G_3 (64.67). These results indicated that quality ratio differ significantly from one an other. It is evident that fine yarns possess better quality ratio than coarse grist yarns. Similar results were reported by Lahiri (9) who reported that range of quality ratio was 75 to 80, 73 to 78, 56 to 73 and 52 to 57 percent for hessian warp, hessian weft, sacking warp and sacking weft respectively. Likewise Morrow (13) concluded same results about quality ratio. However Abdullah *et al.* (2) agreed that quality ratio above 90 and weight CV percent below 23 indicate good quality fibre. Quality ratio above 80 and CV percent below 25 indicate medium quality fibre while quality ratio below 80 and CV percent above 25 points to poor quality fibre. Leach (10) reported that 1 percent increase in CV percent of mass was associated with an approximately 4.70 percent fall in quality ratio of jute yarn.

Table 1 (a) Analysis of variance for quality ratio.

Source of variance	Degree of freedom	Sum of squares	Mean square	F. value	Prob.
C (cutting)	3	4791.215	1597.072	22.7728	0.0000**
S (speed)	3	528.610	176.203	2.5125	0.0599NS
G (grist)	2	21737.273	10868.637	154.9766	0.0000**
CxS	9	252.915	28.102	0.4007	NS
CxG	6	842.238	140.373	2.0016	0.0673NS
SxG	6	355.732	59.289	0.8454	NS
CxGxS	18	830.066	46.115	0.6576	NS
Error	192	13465.115	70.131		
Total	239	42803.164			

*Significant, **Highly significant, NS = Non-significant, CV = 11.04%

(b) Comparison of individual means for quality ratio.

Cutting percentage	Quality ratio(%)	Speed (rpm)	Quality ratio(%)	Yarn grist(pounds)	Quality ratio(%)
C_0 (0)	82.83A	S_1(3400)	77.23	G1(9)	87.93 A
C_1(10)	76.53B	S_2(3600)	77.31	G2(12)	74.95B
C_2(20)	72.85C	S_3(3800)	75.08	G3(16)	64.67C
C_3(30)	71.19C	S_4 (4000)	73.80		

Any two means not sharing a letter in common differ significantly (a = 0.05)

2. End breakage

The results (Table 2) revealed that effect of flyer speed was highly significant. However, effect of cutting percentage and yarn grist was non-significant. In case of interactions, all first and second order interactions also remained non-significant. The high value of coefficient of variation (37.23%) for end breakage indicates that the raw material was of heterogeneous nature and also effect of flyer speed was highly significant. The data further (Table 2b) revealed that the highest value of end breakage (164.00) is recorded for C_3 followed by C_2, (153.92). However, the differences among cutting percentages were statistically non-significant. Thus it can be concluded that end breakage rate is independent of cutting percentage. Ranjan (16) also recorded similar observations.

Table 2 (a) Analysis of variance for end breakage.

Source of variance	Degree of freedom	Sum of squares	Mean square	F. value	Prob.
C (cutting)	3	8891.046	2963.682	0.9014	NS
S (speed)	3	43304.912	14434.971	4.3904	0.0052**
G (grist)	2	1214.758	607.379	0.1847	NS
CxS	9	10290.304	1143.367	0.3478	NS
CxG	6	9167.842	1527.974	0.4647	NS
SxG	6	1349.875	224.979	0.0684	NS
CxGxS	18	4295.258	238.625	0.0726	NS
Error	192	631264.80	3287.837		
Total	239	709778.79			

*Significant, **Highly significant, NS = Non-significant, CV = 37.23%

(b) comparison of individual means for end breakage.

Cutting percentage	End breakage	Speed	End breakage	Grist	End breakage
C_0	148.82	S_1	138.55 A	G_1	156.26 A
C_1	149.38	S_2	145.67 B	G_2	154.88 B
C_2	153.92	S_3	157.95 C	G_3	150.95 C
C_3	164.00	S_4	173.95 D		

Any two means not sharing a letter in common differ significantly (ά = 0.05)

As regards the flyer speed (Table 2b) it is evident that the highest value of end breakage(173.95) is observed for S_4 (4000 rpm) and lowest for S_1 (3400 rpm) (138.55). The results showed that all values of end breakage significantly differ from one another. The data revealed that as the speed increased the breakage rates also increased. These findings are similar to those Lahiri (9) who observed that range of breakage was 95 to 215 breaks 100 spindle/hour for speed of (3560 to 4040 rpm. However, these results slightly differ from some previous studies (7, 16) who recorded the end breakage rate upto 236 breaks/hour/100 spindle. But this variation in end breakage is justified by Atkinson (4) who reported that spinning breakage ratio varied widely from mill to mill due to different quality, frame maintenance and tension. Similarly Mather (11) stated that an increase in card loading affected the spinning breakage rates. For yarn grist (Table 2b), it is noted that the highest value of end breakage (156.26) was recorded for G_1, followed by G_2 (154.88). However, there was non-significant difference among each other.

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