

Effect of Processing Conditions at Ginning on Fibre Properties

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Introduction

The quality of cotton fibre depends upon a variety of factors ranging from seeds and sowing season to picking and other agro-climatic conditions of growth, in addition to post harvest technology employed. The work practices at ginning, storage and transportation before and after ginning also influence the quality of cotton. Hence the quality of bale cotton is not the same even if the variety is same. Earlier work at BTRA has shown that, delay in even first picking leads to inferior cotton fibre properties and fibres with lower maturity ratio tend to show a higher increase in neps after ginning¹. The moisture in kapas plays a vital role in processing at ginning. The seed cotton that is too moist does not separate into locks and tends to form wads which are trapped between knife edge and roller of the roller gin and chocks up the ginning; on the other hand, the seed cotton that is too dry generates static electricity and causes frequent stoppages by accumulating on the surface of the synthetic roller of the roller gin². It is also a known fact that, moisture level in the kapas does not remain same through out the season and therefore causes variation even in the same variety of cotton after ginning. The kapas from the first picking exhibits adequate moisture in the cotton fibres which gets reduced in second and third picking. Therefore it is very much essential to keep optimum level of moisture in the kapas during ginning by positively controlling the humidity in the ginning area, to get maximum ginning out-turn with consistency in fibre quality of ginned cotton. In order to study the effect of moisture in the kapas at the time of ginning on fibre quality of ginned cotton and on ginning out-turn, trials were conducted at different gins by varying the moisture level in the kapas.

Many ginneries are employing pre-cleaner before ginning for removing heavy impurities and immature balls from the kapas and also post-cleaning for removing fragmented trash particles from the ginned cotton. Trials were conducted by varying the number of passages of pre-cleaner before ginning at moisture level of 7% in the kapas. For conducting these studies by varying the number of pre-cleaner passages, a medium staple variety was used in three ginning factories. All these ginning factories were equipped with the widely used double roller gins with pre-cleaner / post-cleaner in their line. Out of three gins, where trials were conducted, one gin was equipped with complete pneumatic system for conveying kapas right from the kapas storing platform to bale press. In such a type of gin, trials were further carried out by pneumatically and manually conveying kapas to the gin in order to know the effect of pneumatic conveying on nepping potential of cotton after ginning. In Gin 1 and 2 trials were conducted on first pick cotton whereas in Gin 3, trials were conducted on second pick cotton.

Experimental Details

Effect of Moisture Level in the Kapas during Ginning

The trials were conducted in three ginning factories and machinery details of each gin are given in table 1.

Table – 1
Details of Ginning Machinery used in the trials

Particulars	Gin 1	Gin 2	Gin 3
Cotton used for trial	RCH-2 Super from first picking.	S-6 from first picking.	S-4 from second picking.
Machinery sequence	Pre-cleaner – Double roller gin – Bale Press	Pre-cleaner – Double roller gin – Post-cleaner – Bale Press	Pre-cleaner - Double roller gin - Post-cleaner - Bale Press
Cotton conveying system	Fully manual	Pneumatic conveying only from Double roller gin to post-cleaner and from post-cleaner to lint house	Fully pneumatic from kapas storage platform to lint house and from lint house to bale press.

The moisture level was checked prior to ginning and at every stage of processing. Three levels of moisture were maintained for the studies. For conducting trials at various level of moisture, the kapas was processed through their usual sequence. The low moisture in the kapas was maintained before ginning by exposing it to the direct sunlight to evaporate the moisture and for maintaining medium and very high moisture level in the kapas, it was exposed to atomized spray to increase the moisture level to the required level to the moisture level. During processing of sample, moisture level was measured in Gin 3 with the help of a moisture meter to record the loss in moisture due to pneumatic conveying at each stage of ginning which is given in table-2.

Table – 2
Moisture level in kapas / lint at various stages of ginning

	Los Moisture	Medium Moisture	Very High Moisture
At Platform	<3.5	7.0	15.0
After Pre-cleaner	<3.5	5.8	10.5
Before Ginning	<3.5	5.5	10.5
After Ginning	<3.5	5.2	6.0
After Post-cleaner	<3.5	4.2	4.2

Studies were commenced in November 1999. In Gin 1 where the first study was carried out at the beginning of the season, the moisture level was around 7% to 10% in different heaps of kapas. However when the kapas is exposed to direct sunlight over the platform, the moisture is lost by evaporation and get reduced to even 4% due to dry region. Hence during the studies extra care was taken to maintain desired moisture level before ginning. The ginned cotton sample were tested on HVI for 2.5% span length and uniformity ratio and results are given in table 3.

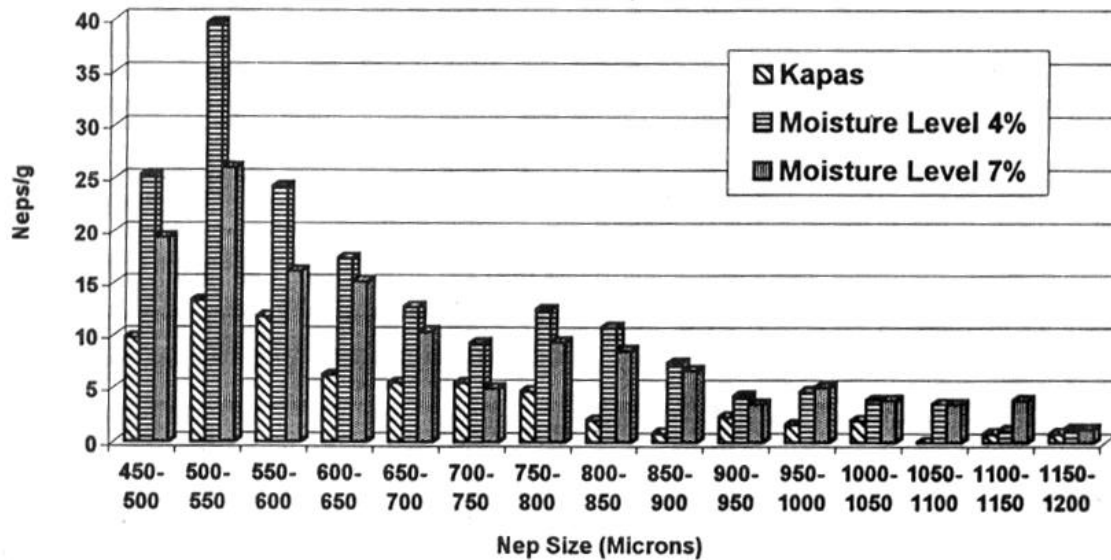
Table – 3
Effect of moisture level in the kapas on fibre length of lint.

Moisture Level in the Kapas	2.5% Span Length (mm.)	Uniformity Ratio
Gin 1		
Low Moisture	28.7	49.79
Medium Moisture	29.8	50.28
High Moisture	30.0	52.35
Gin 2		
Low Moisture	29.0	44.0
Medium Moisture	28.8	46.9
High Moisture	29.2	45.9

It can be seen that, the moisture level does not affect the 2.5% span length in the case of first pick cotton after ginning. However uniformity ratio was found better at medium and high moisture level compared to low moisture.

Neps in Lint, Ginned at Different Moisture Levels

Ginning at Different Moisture Levels



The fibres manually removed from kapas when tested on AFIS Tester shows ‘**Biological Neps**’ in the region of 450 to 700 microns. These neps are caused by immature fibre entanglement and possibly created on AFIS tester also; thus the Biological Neps are originally present in the kapas which is yet to be fed to the gin. Further the ginning process adds neps due to mechanical processing. The increase in neps however depends on moisture content in the kapas, fed to the ginning machine. By maintaining the optimum moisture in the kapas the rate of increase in neps from 450 to 900 micros can be kept low. It is very essential that the neps of smaller size (below 700 microns) are to be kept low, because these neps are more difficult to remove by spinning machines; compared to the neps of bigger size (above 700 microns).

Trash in Ginned Cotton at Different Moisture Levels

Machine ginned cotton from gin no. 1 and 2 were also tested for trash on trash separator and the results are given in table – 4.

Table – 4
Trash in lint at different moisture levels of kapas

Material	Trash %	
	Gin 1	Gin 2
▪ Kapas	1.9	1.1
▪ Lint at Low Moisture	2.0	2.5
▪ Lint After Post Cleaning	-	1.8
▪ Lint at Medium Moisture	2.0	2.3
▪ Lint After Post Cleaning	-	2.1
▪ Lint at High Moisture	2.6	3.0
▪ Lint After Post Cleaning	-	3.0

It was observed that, the trash left in the lint is highest at high moisture in kapas. This is because, dampness in the kapas due to high moisture doesn't permit seed cotton to separate into single locks. This choked lint between the knife edge and the roller in roller gins. In Gin no. 2 where post-cleaner is employed, the trash present in the ginned cotton processed at high moisture level could not be removed effectively.

Ginning Out-Turn at Different Moisture Levels

Apart from studying the quality aspects of ginned cotton, the quantity of lint produced from the given weight of kapas is also important from techno-economic point of view. The cotton fibre is susceptible to moisture and hence, the outturn may vary at different moisture levels. Therefore, the trial was taken at laboratory gin by precisely controlling the moisture during ginning. Kapas of 100 gms. each was weighed and processed on a laboratory gin at three different moisture levels and after ginning lint was weighed. The results are given in table-5.

Table – 5
Out-turn at three different moisture levels.

Moisture Level (%)	Weight of Kapas (gms.)	Weight of Lint (gms.)
3.5	100	34.2
7.0	100	35.6
10.0	100	33.2

It can be seen from the table – 5 that, the kapas at moisture level of 7.0% gives maximum ginning out-turn compared to other two moisture levels.

Effect of Number of Passages of Pre-Cleaner before Ginning on Fibre Length

Before ginning pre-cleaning is done to remove heavy impurities and kawadi from the kapas and during cleaning at pre-cleaning kapas get opened which helps in improving the productivity at gin. In order to see the effect of pre-cleaner on kapas, trials were conducted by varying the number of pre-cleaner passages before ginning. While conducting trials care was taken to maintain moisture level of 7% in the kapas and ginned cotton samples were tested for fibre length on HVI.

Table – 6
Effect of number of passages of pre-cleaner before ginning on fibre length of lint

Particulars	2.5% Span Length (mm.)		Uniformity Ratio	
	Gin 1	Gin 2	Gin 1	Gin 2
Without Pre-cleaner treatment	29.5	30.4	51.6	49.4
With single passage of Pre-cleaner treatment	29.9	28.8	50.3	46.9
With two passages of Pre-cleaner	29.9	28.6	50.9	47.0

The results shows that, in gin no. 1 where studies were carried out at the start of the season on cotton RCH-2, there is no significant difference in 2.5% span length after ginning for sample process without pre-cleaner or with 1 or 2 passages of pre-cleaner. This may be due to the better variety cotton from first picking and better condition of gins. The uniformity ratio was however found better for sample without pre-cleaner compared to sample with single or double passages of pre-cleaner before ginning.

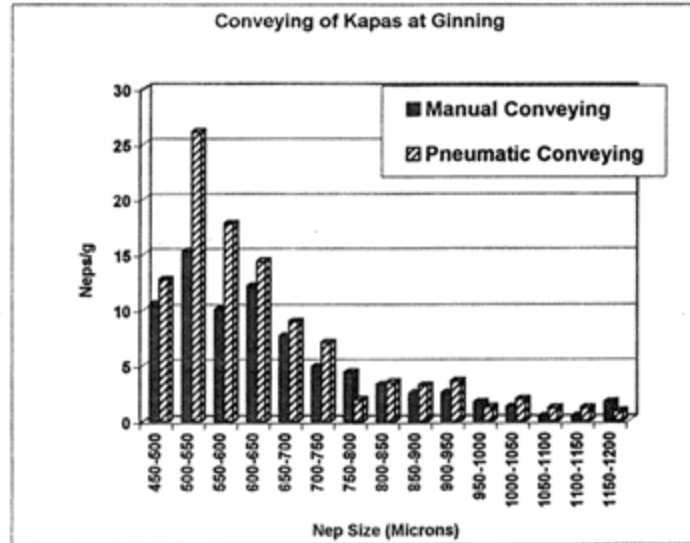
In the case of gin 2 where studies were carried out at the middle of the season on S-6 cotton. The 2.5% span length is comparatively better for the sample without pre-cleaner. The uniformity ratio also exhibits the similar trend.

Effect of Pneumatic Conveying of Kapas on Nepping Potential of Ginned Lint

While conveying lint or kapas, care should be taken that, it should be handled to a bare minimum. Due to excessive handling of cotton there are chances of increasing contamination in the cotton and also immature fibre content in the cotton tends to form neps. To avoid this, in modern ginning factories the kapas and lint is conveyed from one machine to another pneumatically. The same conveying system was adopted in gin no. 3 where kapas is conveyed from storing platform to each machine in the ginning sequence pneumatically. This system minimises the handling of material and handling cost but there is a risk of formation excessive neps due to air current and friction with inner surface of pneumatic pipes. Therefore a trial was conducted on second pick cotton to see the level of nep formation by conveying material to the same gin pneumatically as well as manually, and after ginning, the lint was analysed for nep formation on AFIS. The results are given below (Table-7). The table-7 shows that there is an indication on increase in neps, if lint is conveyed pneumatically.

Table – 7
Effect of Pneumatic conveying on nepping potential of cotton.

Particulars	Conveying Mode (Sample after Ginning)	
	Manual	Pneumatic
Actual neps/g in Lint	71	99
Seed Coat Neps/g in Lint	11	14



Whiteness of Ginned Lint Processed at Various Levels of Moisture and by Varying Number of Passages of Pre-Cleaner before Ginning

Whiteness is also one of the quality parameters of naturally white cotton which gets affected due to repeated handling of material at various stages of gin. The whiteness and reflectance values of first cotton are much higher than the second pick cotton. The samples processed at various levels of moisture and by altering the number of passages at pre-cleaner before ginning were tested on spectrophotometer for whiteness. The results are given in tables-8a and 8b.

Table – 8a
Whiteness index of samples processed at gin at various levels of moisture

	Gin 1	Gin 2
Kapas	41.25	42.33
Lint at low moisture	39.55	38.97
Lint After post-cleaning	-	38.78
Lint at medium moisture	36.12	37.46
Lint After post-cleaning	-	37.82
Lint at high moisture	33.81	38.32
Lint After post-cleaning	-	39.69

Table – 8b
Effect of number of passages of pre-cleaner before ginning on whiteness

	Gin 1	Gin 2
Kapas	41.25	42.33
Without Pre-cleaner treatment	40.22	38.77
Lint After post-cleaning	-	35.13
With single passage of Pre-cleaner treatment	36.12	37.46
Lint After post-cleaning	-	37.82
With two passages of Pre-cleaner treatment	34.70	34.87
Lint After post-cleaing	-	39.88

From the above tables, it can be seen that, the whiteness of hand ginned cotton is on the higher side which gets deteriorated as it passes through the ginning sequence. The effect of moisture level on whiteness index is not clear from the trials. In gin 1, a drop in whiteness was seen with increase in moisture, whereas in gin 2, there does not appear to be any change in whiteness with respect to moisture. This needs further investigation. Further, when pre-cleaner is by passed, the whiteness of lint is retained.

Conclusions

- The moisture level did not affect the 2.5% span length, however uniformity ratio was found better at medium and high moisture level compared to low moisture level.
- The trash left in the ginned cotton is highest at high moisture level and when post cleaner is employed, the trash present in the ginned cotton processed at high moisture level could not be removed effectively.
- The kapas at moisture level 7.0% gives maximum ginning out-turn compared to other two moisture levels.
- There is no significant difference in 2.5% span length after ginning for sample processed without pre-cleaner or with one or two passages of pre-cleaner, but the uniformity ratio was found better with ginned cotton sample processed without pre-cleaner.
- By maintaining the optimum moisture in the kapas, the rate of increase in neps in the size 450 to 900 microns can be kept low.

References

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