Challenges when defining cotton quality and processability without elongation

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INTRODUCTION

Experiment 1 of this study was performed on the 60 samples from commercial DP-90 cotton genotypes in the three cotton cultivating areas of Gondar region, namely:

- Almehal, Kokyt and Abderafi
- The experiment was performed for the comparison of their technological values by the commercially used quantification methods. Samples were tested on USTER HVI-1000, with 50 replications.

Experiment 2 of this study was performed on the 75 samples from commercial DP-90 cotton genotypes cultivated in all areas of Gondar region. (this covers all cultivation areas shown by the red mark in the map) The samples were tested on USTER HVI-1000 and Version 5 CCS instruments, with 50 replications.

The experiment was performed to demonstrate the association between “Tenacity” & “Elongation”

Why Elongation Property is so Important?

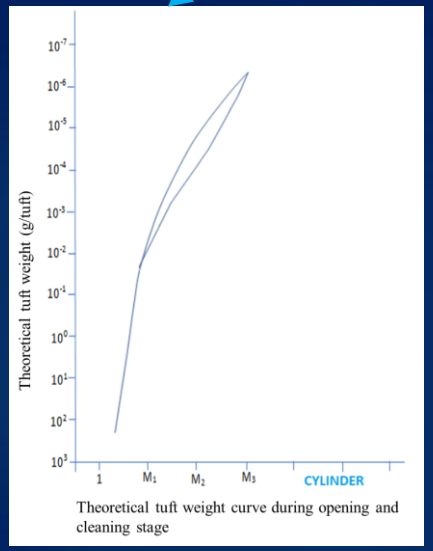
- Stronger fibers tend to have higher elongation which results in better work-to-break which could lead to lower fiber breakage during processing (Hequet et al. 2016)
- The work-to-break (work-of-rupture) is a measure of the ability of a fibre/fibres to withstand sudden shocks of a given energy during processing
- during fiber processing the stress is not applied to bundle of fibers but to individual fibers or small tufts of fibers.

Elongation and cotton processing

- Opening and cleaning stage machinery acts on the tufts in the order of few milligrams
- Carding machinery parts acts only in few tens of fibres.
- In ring frame, the fibres are drafted to individual fibres and then get twisted by the traveler to the required yarn count
- In rotor spinning only few fibres comes to the highly rotating section of the rotor to join and get twisted by the crank action of the open end yarn.

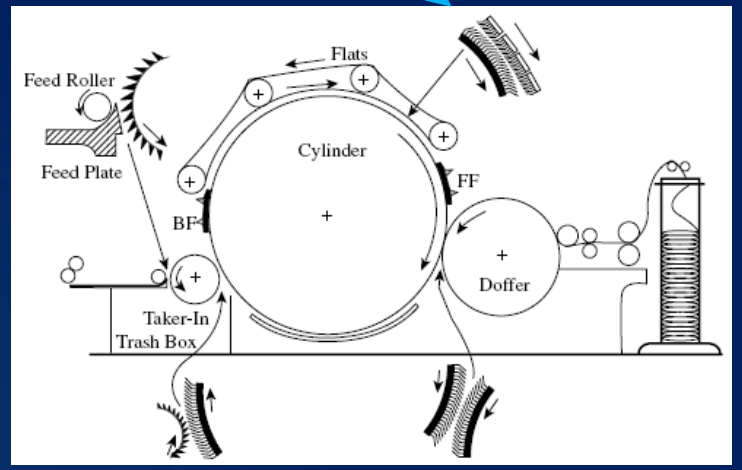
Stress is applied to individual fibres or small tufts

Into few milligrams

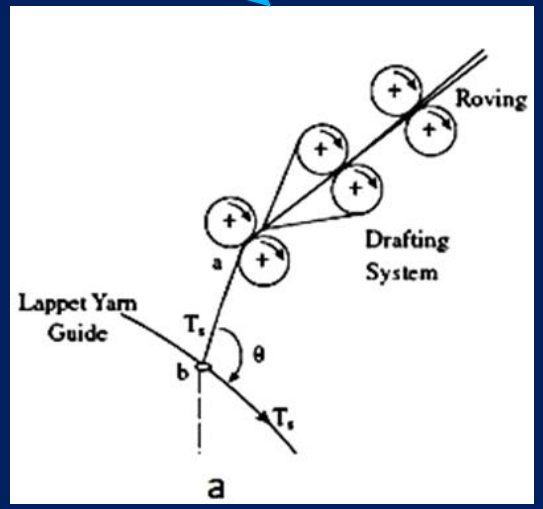


Theoretical tuft weight curve during opening and cleaning stage

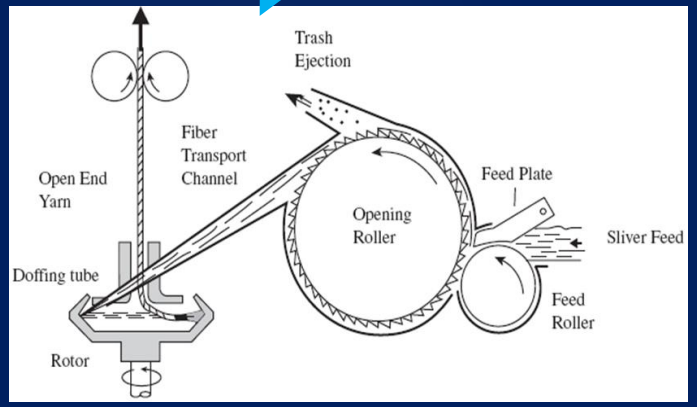
Into few tens



Fibre individualization and attenuation



Few Fibres are coming



Results and Discussions

Cotton Cultivating Areas	Stat.	Mean HVI Fibre Properties							
		MIC	UHML	UI	SFI	FS	FE	Rd	+b
Abderafe	Mean	4.10	29.56	86.02	6.47	30.26	6.53	84.75	9.69
	Min	3.51	28.31	84.80	5.80	28.10	6.00	83.00	8.40
	Max	4.57	30.51	87.50	7.30	32.10	7.00	87.00	10.50
	S.D	0.37	0.74	0.77	0.54	1.24	0.34	1.27	0.59
Almehal	Mean	3.88	27.24	81.99	10.73	26.79	5.75	78.07	12.28
	Min	3.77	26.39	79.30	7.30	24.10	5.00	75.30	11.60
	Max	3.97	28.08	84.30	14.10	29.10	6.70	79.50	12.80
	S.D	0.06	0.68	1.68	2.09	1.68	0.50	1.59	0.31
Kokyt	Mean	4.27	29.25	83.70	7.55	27.46	6.67	83.16	9.44
	Min	4.05	28.26	78.30	6.70	26.30	6.20	73.80	9.10
	Max	4.55	30.46	86.60	9.10	28.80	7.80	87.00	9.60
	S.D	0.20	0.63	2.73	0.73	0.81	0.49	4.94	0.16

Instrumental Technological values

Cotton Cultivating Areas	HVI Fibre Properties Cultivated in the Three Areas								The calculated Technological values by Quantification Methods and their Ranks			
	MIC	UHML	UI	SFI	FS	FE	Rd	+b	SCI	R	FQI	R
Abderafe	4.10	29.56	86.02	6.47	30.26	6.53	84.75	9.69	158.2	3	187.7	3
Almehal	3.88	27.24	81.99	10.73	26.79	5.75	78.07	12.28	123.3	1	154.2	1
Kokyt	4.27	29.25	83.70	7.55	27.46	6.67	83.19	9.44	135.9	2	157.4	2
								Mean	139.1		166.4	

Technological values of cotton by SCI

According to SCI:

- Abderafe has the highest technological value (158.2) followed by-
- Kokyt (135.9) and Almehal (123.3).
- This is expected that the main positive contributors in this quantification method namely, fibre **strength**, **UHML** and **UI** was the highest values in the Abderafe cotton for the studied cotton samples.

Technological values of cotton by FQI

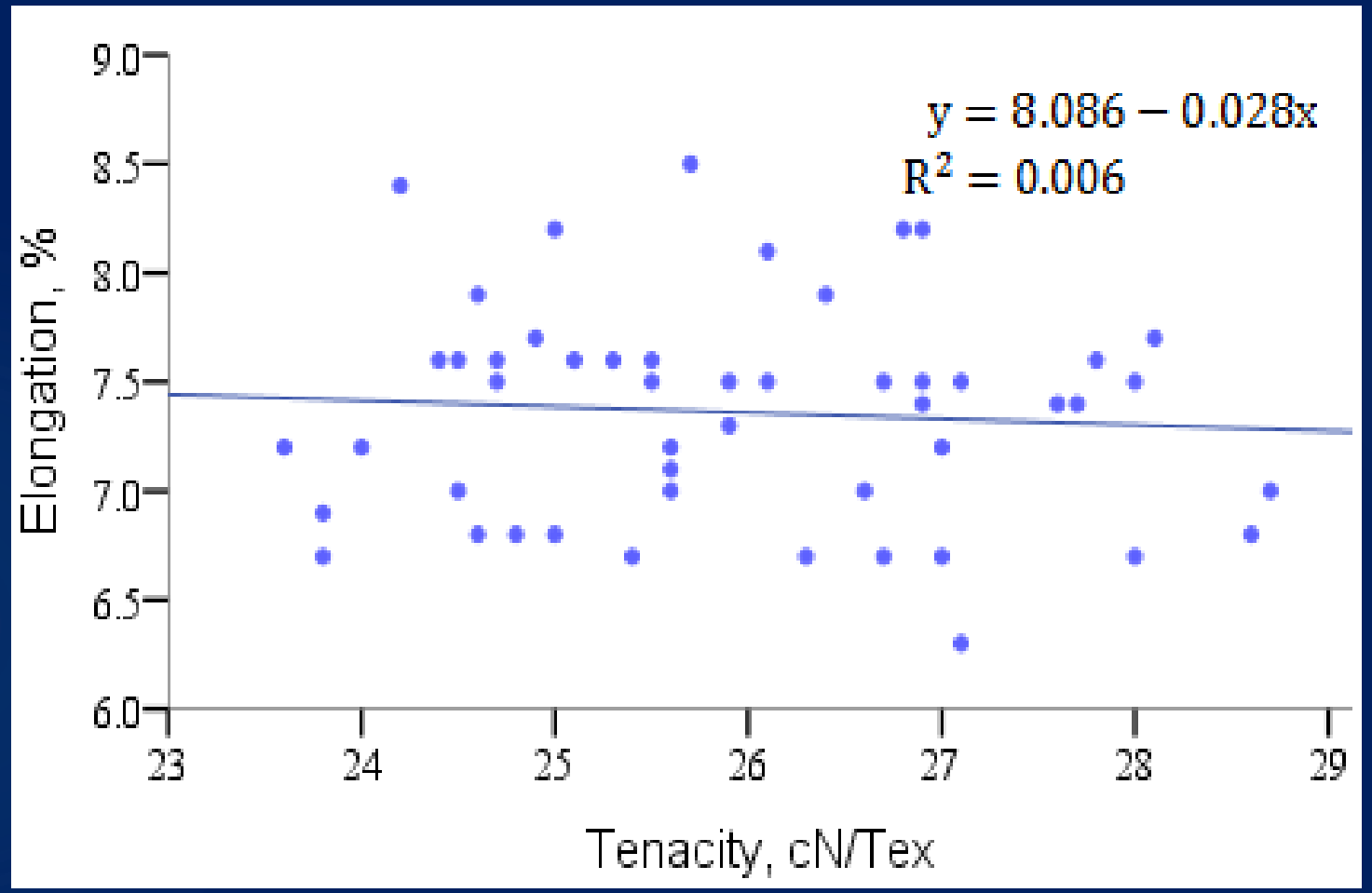
According to FQI:

- Similar technological rank (R) shown
- 187.7-FQI (Abderafe), 157.4-FQI (Kokyt) and 154.2-FQI (Almehal).
- As it was before, all the positive contributors in this quantification method was the highest values in the Abderafe cotton for the studied cotton samples.

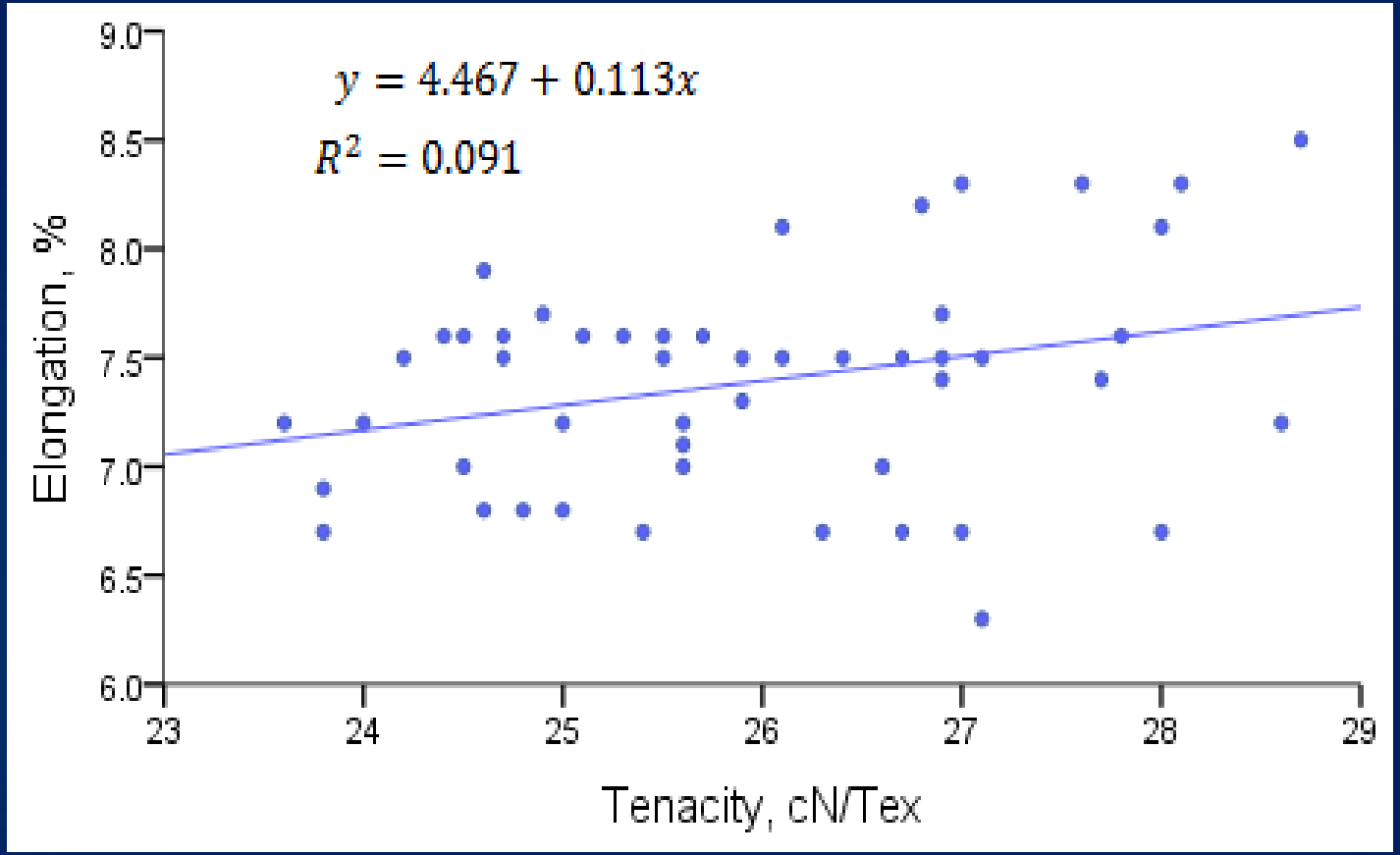
In both quantification methods emphasis is not given to the "elongation" parameter which has to be importantly considered during the speed and striking action optimization of spinning machinery parts.

Then, is it not be a challenge when defining cotton quality and processability without properly evaluating "Elongation"?

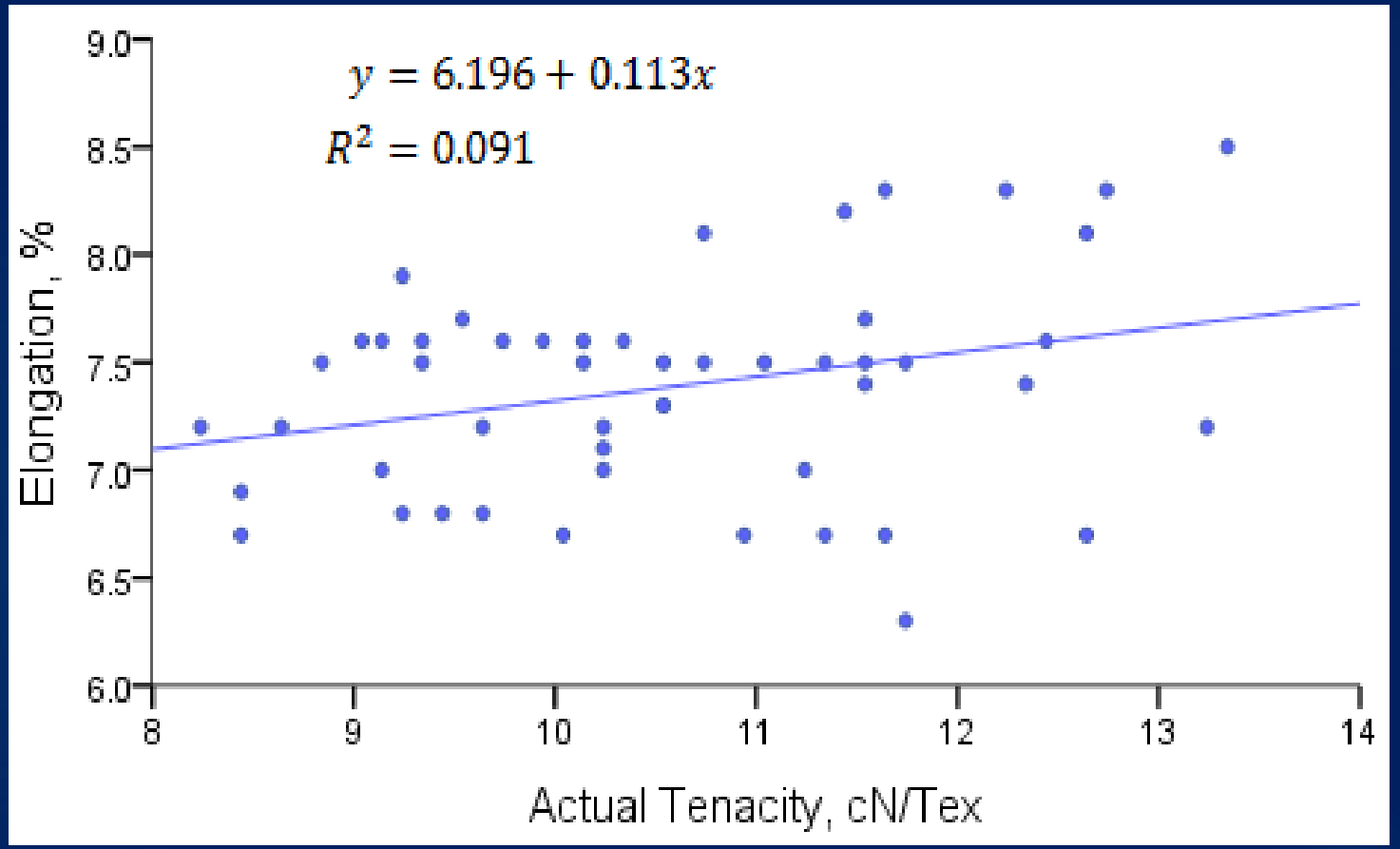
HVI Tenacity-elongation relationships



CCS Tenacity-elongation relationships (HVI MODE)



CCS tenacity-elongation relationship (absolute/actual MODE)



Tenacity-Elongation Relationship

- The result in this research work also proved that, Fig. 1, there is a negative relationship between HVI bundle tenacity and elongation-at-break ($r^2 = 0.006$) for the studied commercial variety DP-90.

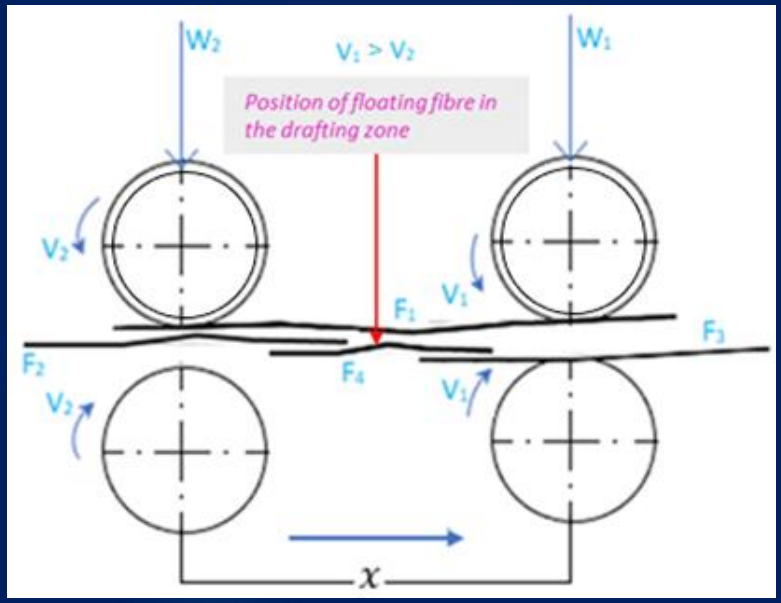
- But it is found that there is a positive but weak relationship between CCS bundle tenacity and elongation-at-break. Fig. 2 relationship between CCS bundle tenacity and elongation-at-break (HVI/relative mode), ($r^2 = 0.091$) and

- fig. 3 relationship between CCS bundle tenacity and elongation-at-break (direct/absolute mode), ($r^2 = 0.091$) for the same commercial variety DP-90.

Conclusion

- The practices of ignoring cotton fibre **elongation** property should be avoided.
- Ignoring for cultivating improved cotton fibre elongation property could lead to lower work-to-break with more fibre breakage.
- Short fibres are sources of draft irregularity
- They could affect the Quality of final textile products by living more thin and thick places in the yarn body.

Therefore, it can reasonably be concluded that the fibre parameter of **elongation** is to be considered while cultivating cotton and arriving at the formula for the evaluation of cotton fibre quality and processability.



Thank you