

Developing technical plans for processing Australian industrial hemp straw

PRJ-012551

Jun20 – Sep22

Introduction

- Crop management – G x E x M effects
- Fibre processing
- Yield
- Quality
- Other fibre processing systems
- Conclusions



Genetics x (environment x) management

For yield...

- Genetics (48%)¹
 - Managed selection & cross-breeding
- Management (28%)
 - Agronomy, harvest & post-harvest practice/process
- Interaction between Genetics & Management (24%)
 - The magnitude of G x M interaction varied with region (E)

1. Liu, S. M., et al., (2013) The interaction between breeding and crop management in improved cotton yield. *Field Crops Research* **148**, 49-60

Genetics x (environment x) management

Variance in fibre quality attributed to G, E and classing error²

Source	Length % of total var.	Tenacity % of total var.	Micronaire % of total var.	Elongation % of total var.
Region (E)	59.18	26.04	66.22	65.25
Variety (G)	30.57	44.01	26.61	24.23
Classing date (e)	0.00	4.71	0.99	1.68
Error	10.25	25.24	6.18	8.84

2. Gordon, S. G., and Yang, S., (2017) Measuring and managing fibre elongation for the Australian cotton industry, Final Report to CRDC, 12 pp.

Stem processing (for fibre) options

- *Farm machinery – reasonable hurd separation*
- **Farm decorticators – reasonable hurd & fibre sheath separation**
- *Cotton ginning equipment – ability to be adapted*
- *Decorticator with fibre cleaning – good partitioning hurd & fibre*
- **Short-staple preparation – fibre quality for short staple & non-wovens**
- **Long-staple preparation – fibre quality for 100% long staple**

Harvested straw samples

- Some samples partly refined on farm/others just baled
- Sent to Alberta Innotech in Vegreville, Alberta for processing
- Also 'processed' through the CCC gin
- Resulting fibre tested at CSIRO & *cf.* with reference samples



Alberta Innotech process

- Guillotine
- Hopper Feeder
- Decorticator (hammermill)
- Cleaner
- Hopper Feeder
- Decorticator
- Cleaner
- Hopper Feeder
- *Fine Opener*
- Step Cleaner
- Baler



Gin process

- Opening beater →
- Horizontal Cleaner →
- Inclined Cleaner →
- *Stick Machine*
- **Inclined Cleaner** →
- **Conveyor Distributor**
- **Gin Feeder** →
- (*Lint Cleaner*) →?
- *Battery Condenser* →?
- Baler

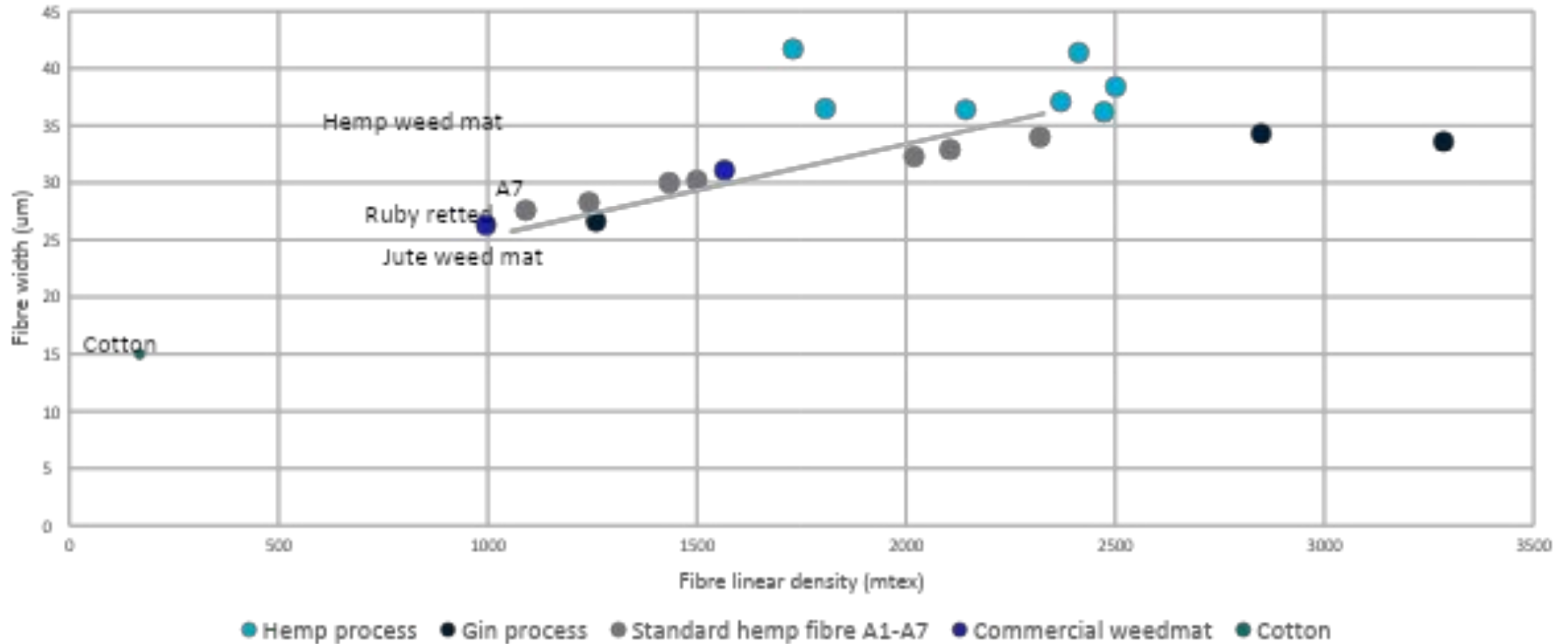
↻ x 2



Harvested fibre yields

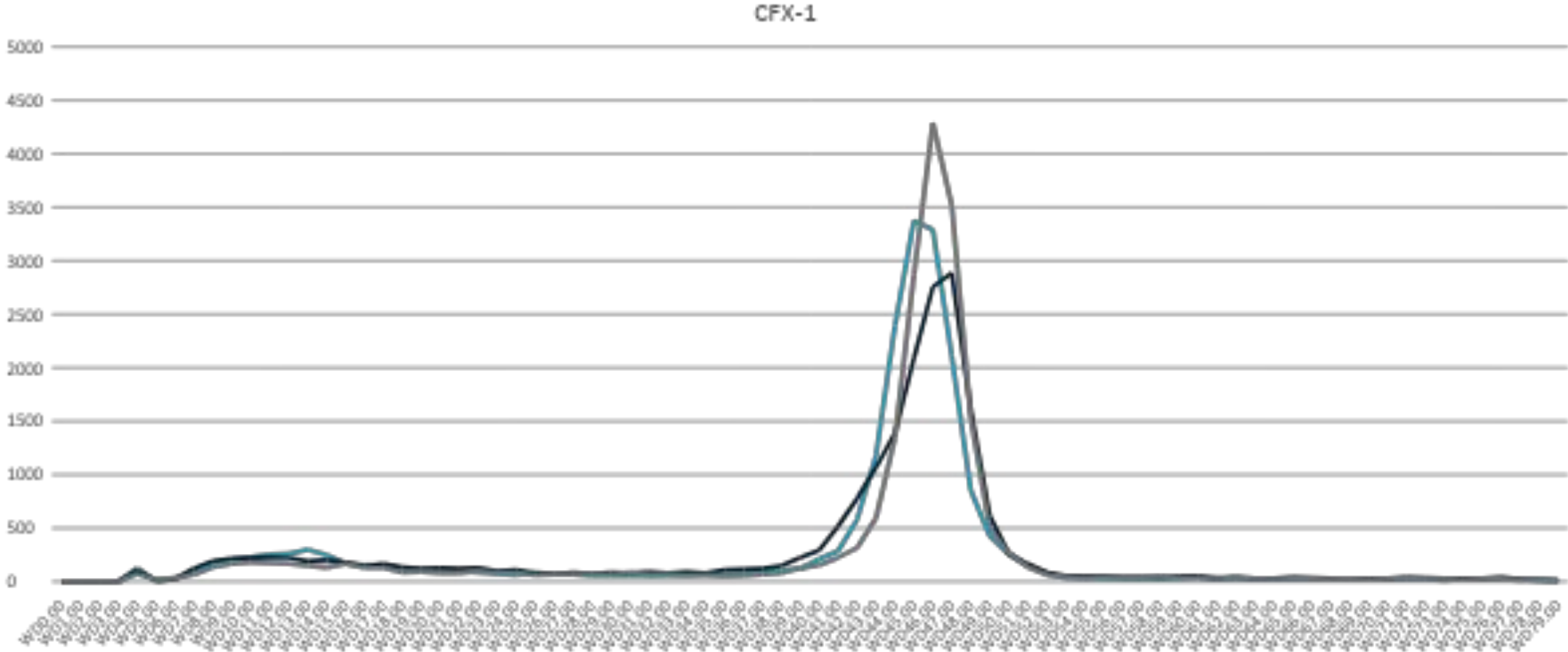
Variety	Bast (Fibre) %	Hurd	% Trash	% Dust	Stem harvest (t/ha)	Clean fibre (t/ha)
CRS-1	10.4	47.1	8	34.5	3	0.3-0.4
CFX-1	12.7	42.5	9.1	35.7	3	0.4-0.5
PR13	10.7	58.2	9.5	21.6	4	0.4-0.5
Excalibur	15.7	42.1	9.6	32.6	5	0.7-0.9
Han Ne	22.7	41.8	8.5	27.0	8	1.5-2.0
Frog	7.3	47.6	8.5	36.6	10	0.7-0.8
Ruby*	19.9	39.4	13.6	27.1	5	0.9-1.1
AV.	14.2	45.5	9.6	30.7		
MS77 early	16.5	?	>80**	?	4***	0.6-0.7
MS77 late	14.0	?	>80**	?	4***	0.5-0.6
Cotton (irr.)	(38-40 [#])					2.3-3.6
Cotton (dry)	(36-38 [#])					1.1-1.8

Processed fibre quality



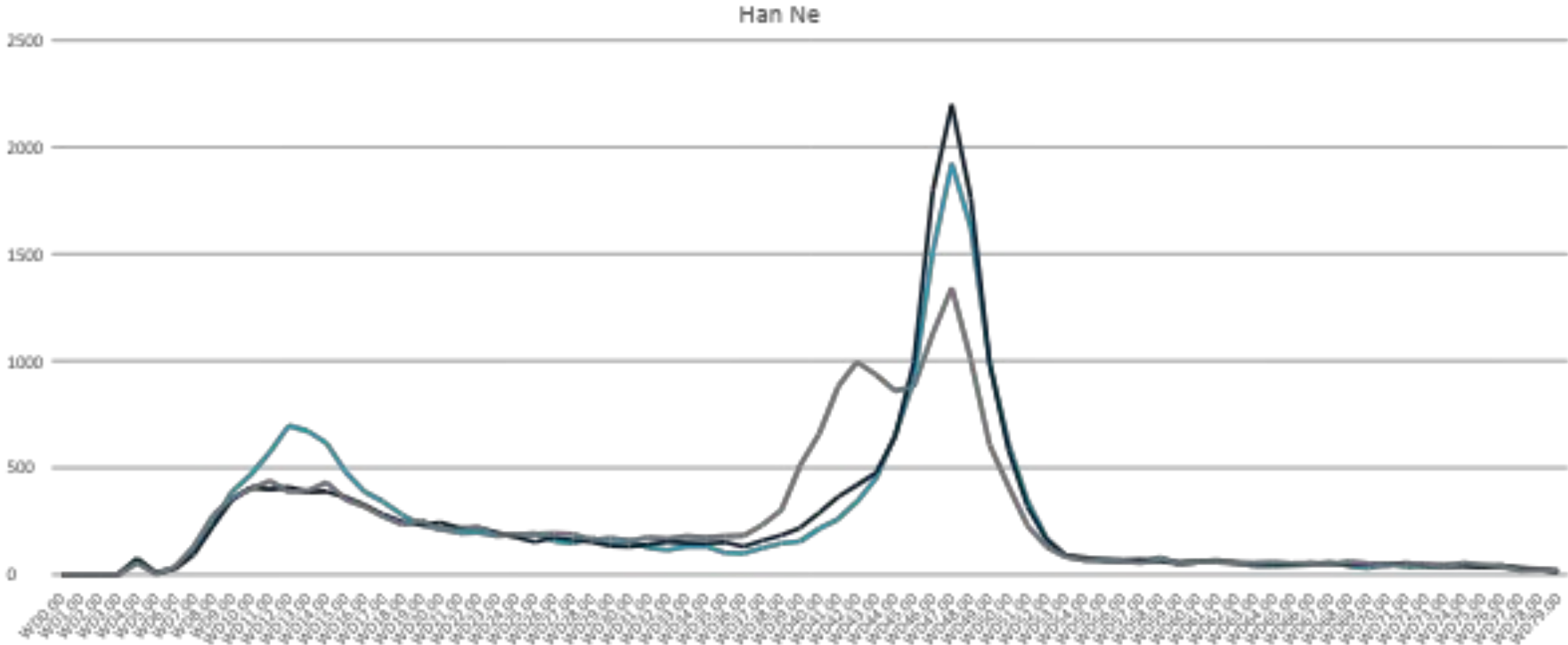


Processed fibre quality

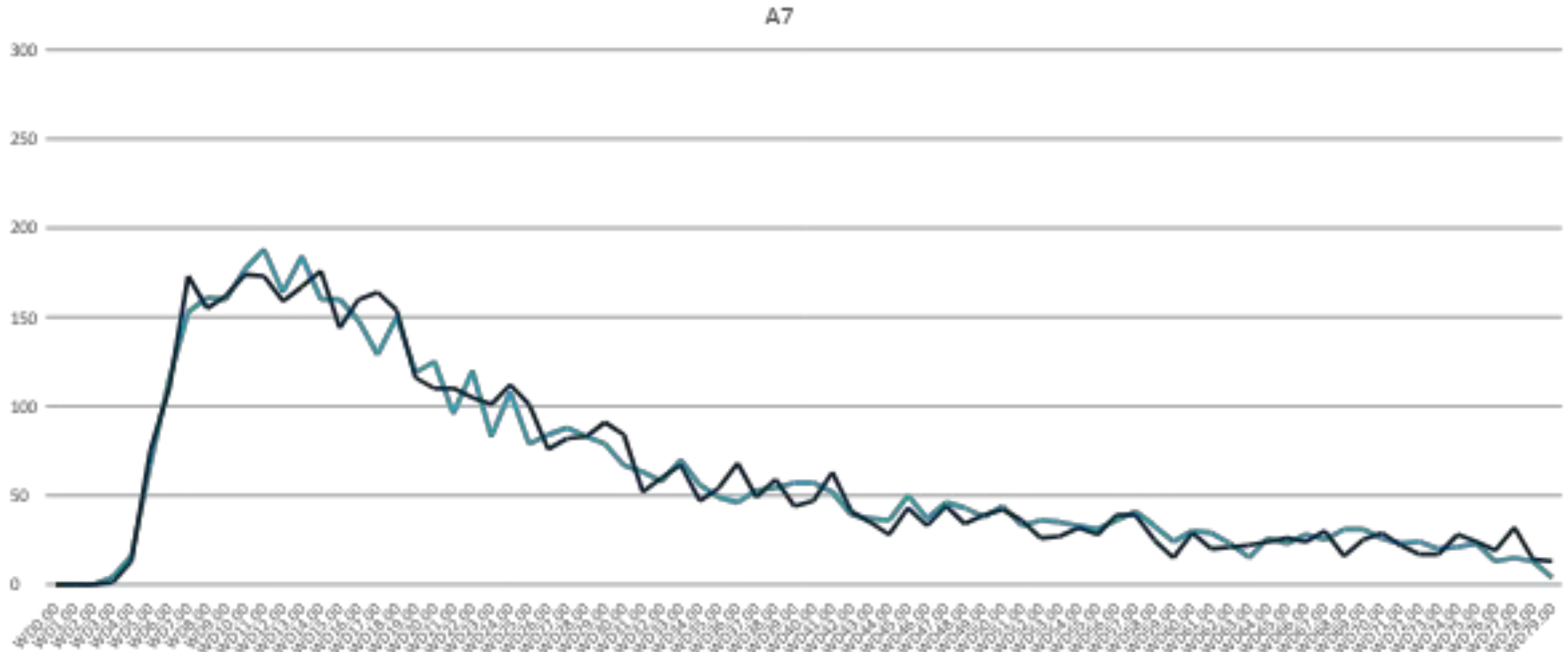




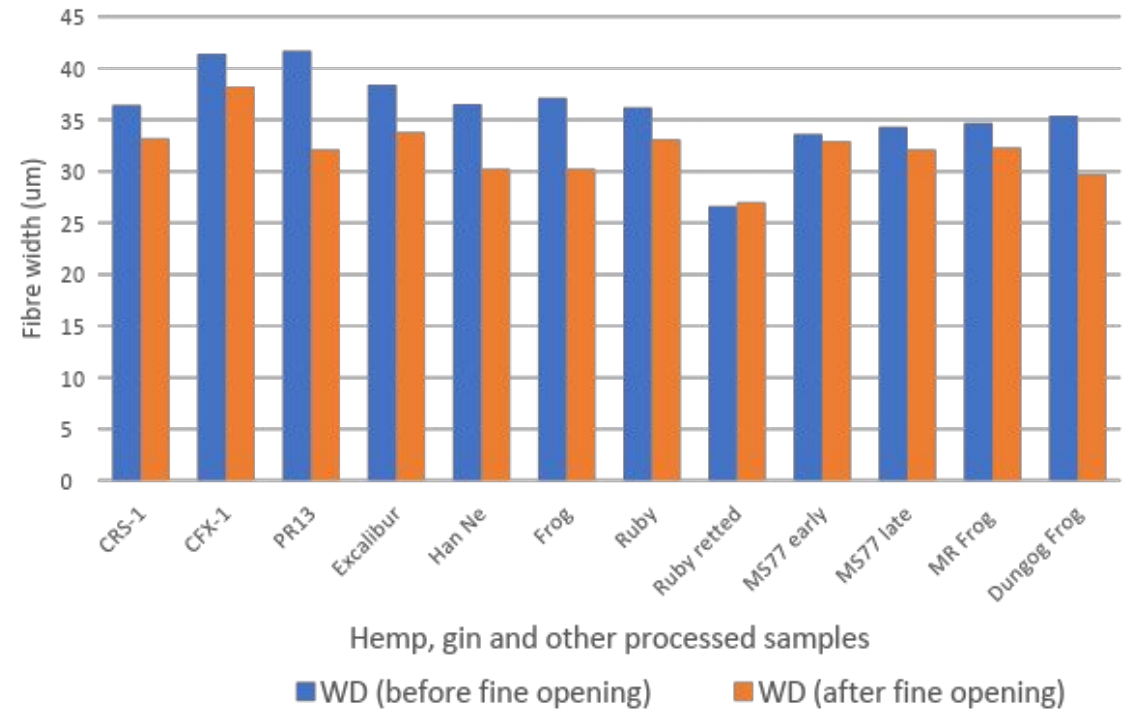
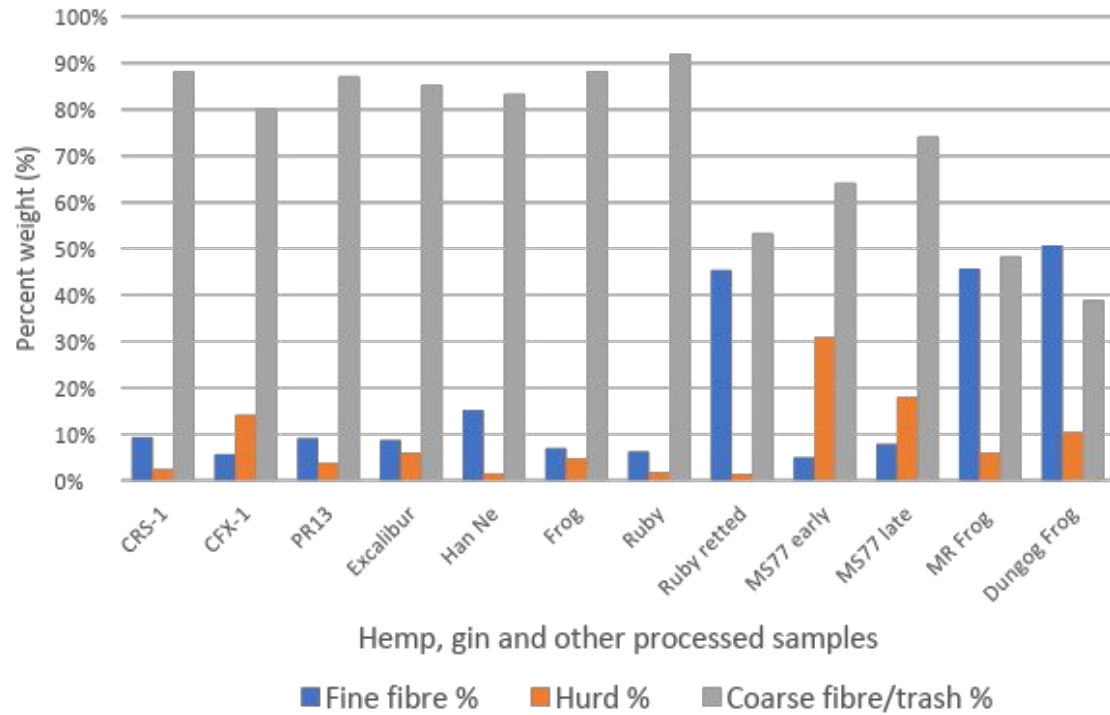
Processed fibre quality



Processed fibre quality



Processed fibre quality



Conclusions: Viability of fibre

- Too coarse for spun yarn
- Too contaminated with hurd for most non-woven processing

REQUIRES

- Further (progressive) cleaning and separation
- Perhaps degumming
- Reopening and blending

Conclusions: Gaps/extension/investment

- Variety, sowing density & harvest date for fibre yield?
- Harvest; moisture & billet length?
- Retting period & conditions (windrowing, swathing & tedding)?
- Baling & storage?
- Where to process, how to market, how to return benefit to grower?

Acknowledgements

- AgriFutures Australia (Olivia Reynolds, Kirsty Williams & Bek Farrugia)
- CSIRO (Menghe Miao, Glenda Howarth & Jan Hair)
- AHC & AIHA (Tim, Bernard, James & Charles)
- Margaret River Hemp, WA Gary & Georgina)
- Andi Lucas & the X-Hemp growers, Cressy TAS
- Peter Righetti & John Middleton from Hepburn Ag, Smeaton VIC
- Gavin Hopkins from D.J. & P.A. Hopkins Pty. Ltd., Wentworth NSW
- Bob Doyle from Doyle Rural Services, Dungog NSW
- Darren Christie from the Australian Hemp Manufacturing Company, Neerim South VIC
- Jaimie Milling & Kirsten Lunoe from CannaHempCare, Dunedoo NSW
- Ian Wise from Prime Farming, Tamworth NSW
- Scott Davies & staff from the Carroll Cotton Company gin, Carroll NSW
- John Muir from Hemp Farming Systems, Maleny NSW
- John Wightman, Natural Resource Development