Harvesting residual corn stover for animal bedding

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Spring harvest 2009

Spring harvest 2010

Corn stover for bedding

- high feedstock potential
  - 380 000 ha/year
  - 8.6 t DM/ha

- high absorption capabilities
- low harvest cost
- decrease phosphorus inputs

Objectives

1. to study spring harvest of corn stover.

2. to compare field capacities of two harvest sequences (round baler and self loading wagon).

Site

- beef cattle feedlot
- 3200 heads over 2 sites
- > 1000 ha in cropped area
- ~ 300 000 $/year in bedding

Harvest sequence 1

1.

Flails windrower Hiniker 5610

2.

Round baler
New Holland 648

3.

Model (Round baler)

Mowing:

$$t_s = \left(\frac{A}{C_s}\right) + \left(2\frac{x}{v} + t_c\right)$$

Baling:

$$t_{b,1} = \left(\frac{A}{C_b}\right) + \left(2\frac{x}{v} + t_c\right)$$

Load/unloading:

$$t_{b,2} = \frac{AY_i E_b}{m_b}\left(t_{b,l} + t_{b,u}\right)$$

Transport:

$$t_{b,3} = \frac{AY_i E_b}{r\,m_b}\left(\frac{x}{v_{b,t}} + \frac{x}{v}\right) + \left(\frac{x}{v_{b,t}}\right)$$

Harvest time:

$$t_h = t_s + t_{b,1} + t_{b,2} + t_{b,3}$$

Harvest sequence 2

1. 

Flails windrower Hiniker 5610

2. 

Self loading wagon Pöttinger Jumbo Combiline 6600

3. 

Model (SLW)

Mowing: $$t_s = \left(\frac{A}{C_s}\right) + \left(2\frac{x}{v} + t_c\right)$$

SLW loading: $$t_{w,1} = \frac{1}{\eta_{th}}\left(\frac{AY_i E_w}{D}\right)$$

Trans. + unload.: $$t_{w,2} = \left[\frac{AY_i E_w}{m_w}\right]\left[\left(\frac{x}{v_{w,t}} + t_{w,u} + \frac{x}{v}\right) + \left(\frac{x}{v_{w,t}} + t_{w,u}\right)\right]$$

Harvest time: $$t_h = t_s + t_{w,1} + t_{w,2}$$

Corn stover yield

	Round baler sequence	Self loading wagon seq.	Average or sum *
Pre-harvest sampling			
Yield (t DM/ha)	4.05	3.23	3.89
Yield standard deviation (t DM/ha)	0.85	0.60	0.84
After shredding/windrowing			
Yield (t DM/ha)	2.42	1.85	2.33
Harvested corn stover			
Total amount (t WM)	35.9	15.3	51.2 *
Area (ha)	22.9	7.7	30.6 *
MC (%)	8.0	6.8	7.4
Yield (t DM/ha)	1.44	1.85	1.55
Biomass recovery (%)	36	57	40

Pick-up

Field speeds and capacities

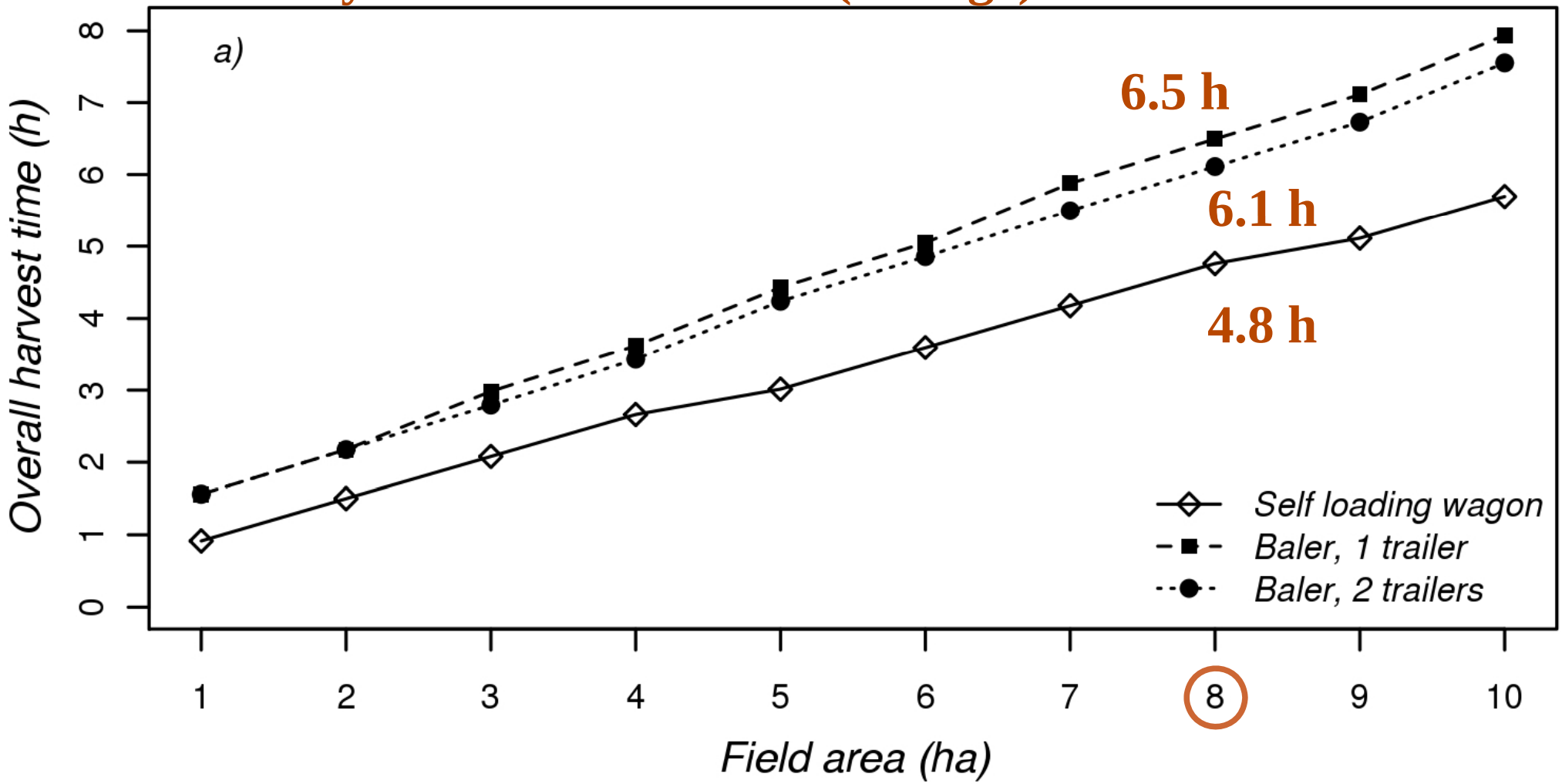
	Flails windrower	Round baler	Self loading wagon
Field speed (km/h)	12.3	5.0	16.0
Mass flow rate (t DM/h)	17.4	5.5	16.7
Theo. working width (m)	4.57	9.14	9.14
Field capacity			
Effective (ha/h)	5.1	3.8	
Theoretical (ha/h)	5.6	4.6	14.6
Field efficiency (%)	90	84	

Transport parameters

Self loading wagon	
Avg. corn stover mass per travel (t DM)	2.85
Unloading time (s)	90
Corn stover loaded travel speed (km/h)	20.6
Round baler	
Avg. bale mass (kg DM)	191
Bale trailer travel speed (km/h)	23.2

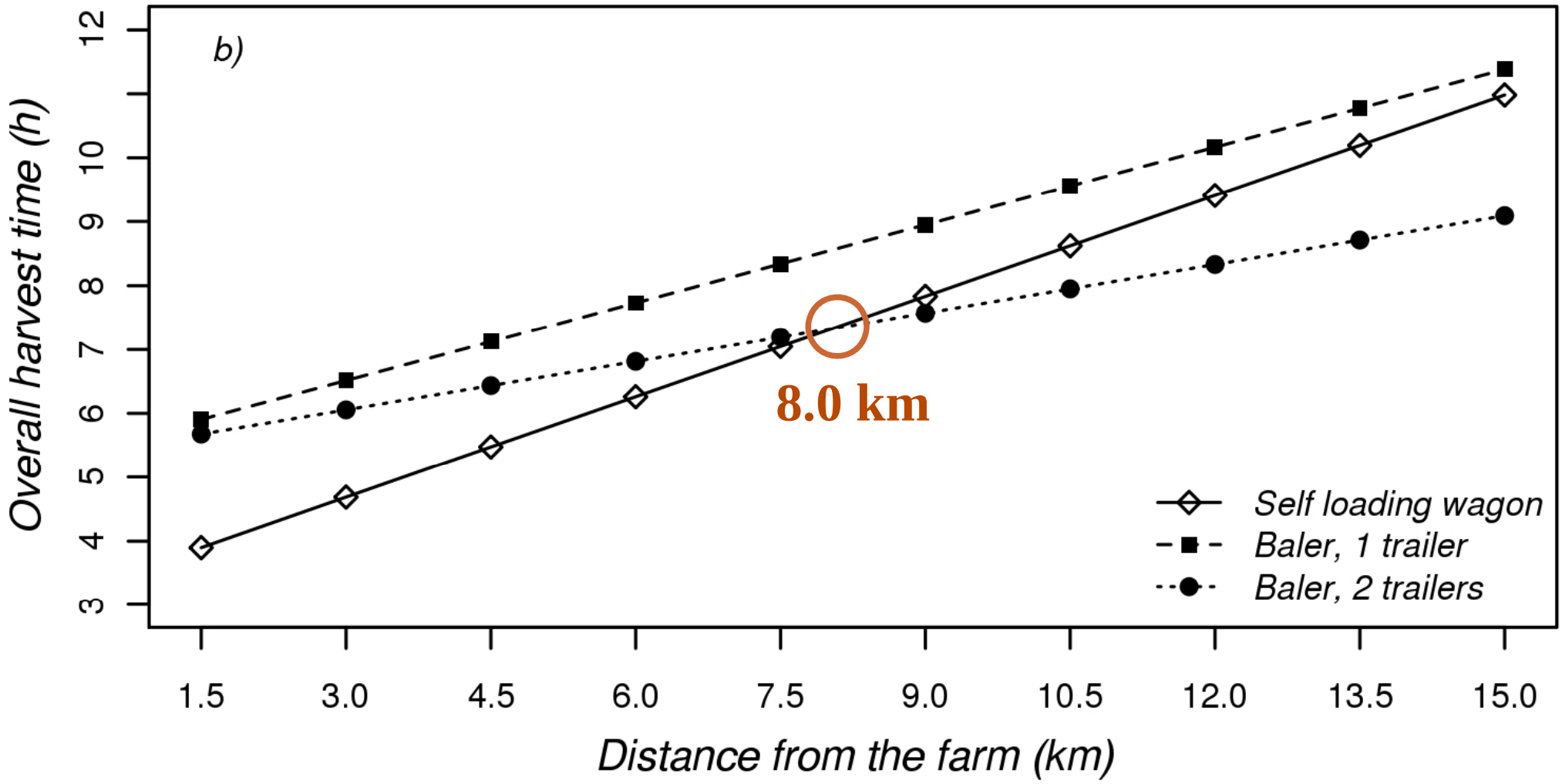
Modelling (Field area)

- field at 2.5 km of the farm
- stover yield of 3.89 t DM/ha (earlage)



Modelling (Distance)

- field of 7.7 ha
- yield of 3.89 t DM/ha (earlage)



Conclusion

- stover at a MC of 7.4 %
- 40 % of residue was harvested
- harvested stover yield of 1.55 t DM/ha (earlage)
- pick-up design would affect losses
- self loading wagon had a high harvest efficiency:
    1. overall harvest time
    2. harvested yield

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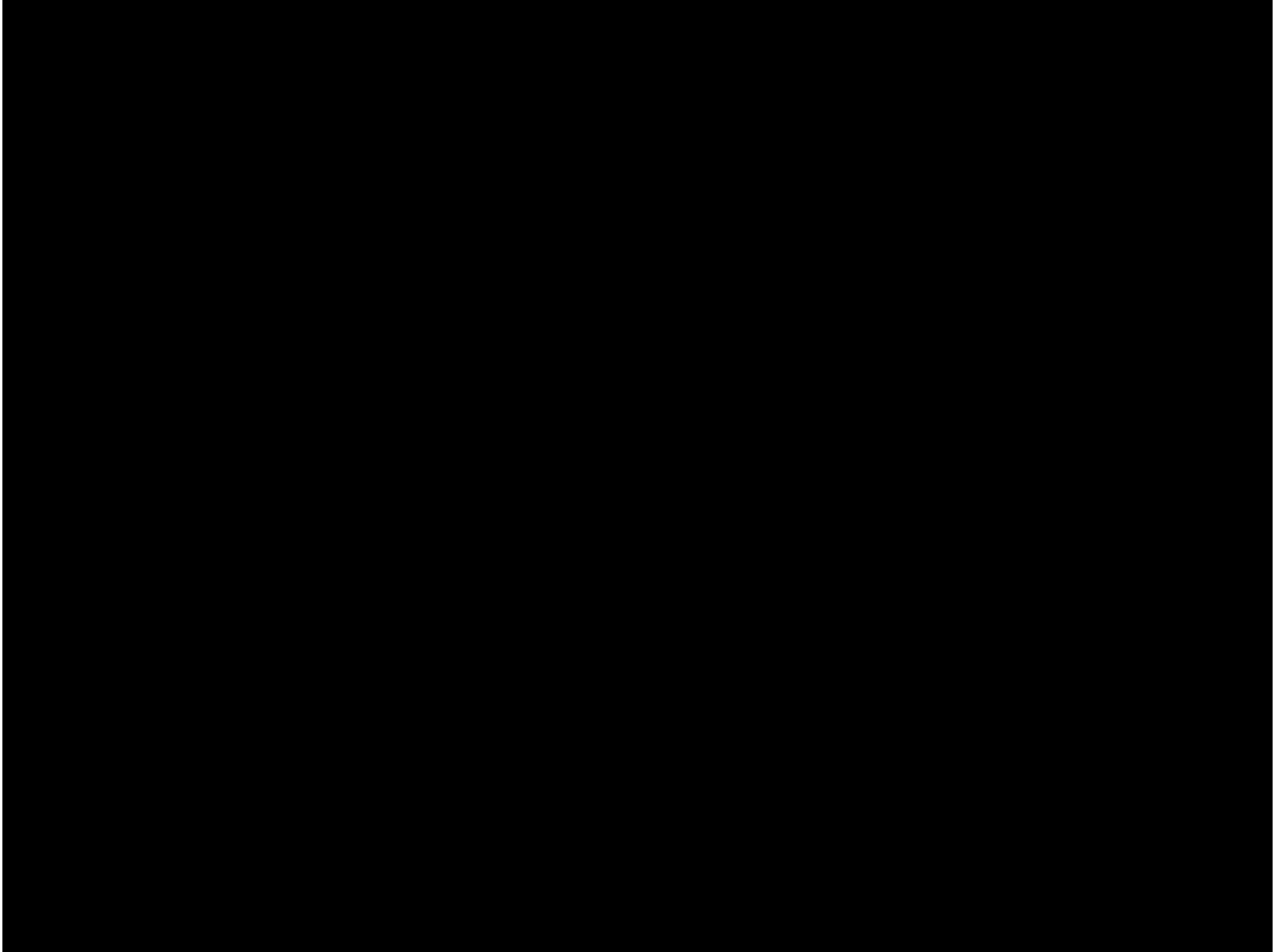

Absorption factor

Matériau	Capacité d'absorption d'eau % (FPBQ)	Facteur d'absorption (OMAFRA)	Prix ($/t) (FPBQ)
Sciure de bois en vrac	142	2,0	58 à 63
Ripe en vrac	138	1,75	58 à 63
Sable	0,3	0,3	36
Paille en balle	259	2,2	50[a], 170[b]
Foin en balle	223	3,0	70[a], 200[b]
Panic érigé	< 278		45 à 75[a]
Paille de canola	343		25[a]
Paille de soya	278		51[a]
Cannes de maïs	250	2,5	11[a]

[a] récoltée à la ferme

[b] à l'achat