HYBRID POPLAR GROWTH AND CARBON STOCKS IN SHELTERBELTS IN SASKATCHEWAN

No. SASK-12

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Tree growth (3PG model) and C dynamics (CBM–CFS3 model) modelling approaches were used to determine the total ecosystem C (TEC) stocks and C stocks additions in hybrid poplar shelterbelts in Saskatchewan. Our growth curves and biomass prediction values (Figure 1) were limited to age 60 years. All older–than–60 years shelterbelts were assigned a conservative, 60–year biomass estimate. Differences in climatic and soil conditions caused the wide ranges of hybrid poplar growth in shelterbelts: mean aboveground biomass (stems, branches, bark), at age 60 years, was 397–634 Mg Km^{-1}, diameter at breast height (DBH) was 52–63 cm, and height was 15–17 m (Figure 1). The growth curves were used as input in the CBM–CFS3 model to produce an inventory of the carbon stocks (Table 1) in all hybrid poplar shelterbelts planted from 1925 to 2009.
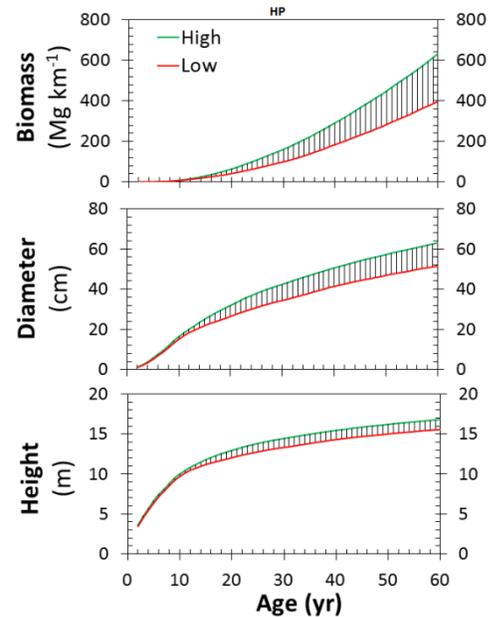

Figure 1. Hybrid poplar growth in shelterbelts – range of biomass, DBH diameter, and height.

CARBON STOCKS INVENTORY

- TEC stocks and C stocks additions in hybrid poplar shelterbelts were 1.3 and 0.68 Tg (1 Tg = 1 million Mg), respectively. About 83% of these C stocks additions (0.57 Tg) occurred since 1990, regardless of tree planting period, and have an estimated value of $31.2 million, at $15 per Mg CO_2–eq (Table 1).

- About 23% (942 Km) of all hybrid poplar shelterbelts (4,144 Km) were planted in the last 25 years.

- For six common shelterbelt species in Saskatchewan, the total length of hybrid poplar shelterbelts is 8.2%, and the TEC stocks stored in them is 12%, of the cumulative length and TEC stocks, respectively.

- Although 85% are in the Dark Brown soil zone (Table 1), hybrid poplar shelterbelts represent a consistent 5%, or greater, spatial occurrence across the province, compared to other common shelterbelt species. In the Dark Gray and Gray soil zones, they represent up to 30% of the cumulative TEC stocks (Figure 2).

Table 1. Total ecosystem C and C additions stocks in hybrid poplar shelterbelts in Saskatchewan.

Hybrid poplar shelterbelts planted 1925-2009

HP: 2015 C stocks and estimated length

Soil zone	Total Ecosystem C		C Additions		Length
	Since 1925	Since 1990	Since 1925	Since 1990	
	------ Mg C ------		------ Mg C ------		Km
Gray	4,265	2,949	1,654	1,622	18
Dark Gray	45,745	27,326	21,611	19,121	105
Black	110,664	62,879	51,460	43,987	105
Dark Brown	858,627	481,815	425,176	357,245	3,555
Brown	284,090	159,571	184,284	146,122	361
Totals (Mg C):	1,303,391	734,540	684,186	568,097	4,144
(Tg C =)	1.303	0.735	0.684	0.568	

North ← South

RELATIVE OCCURRENCE AND C SEQUESTRATION RATE

- Hybrid poplar fast growth and its C sequestration potential make it a very desirable species for shelterbelt establishment (Figure 2)
- The average C sequestration rate was 6.03–6.54 Mg C Km^{-1} yr^{-1}, the highest being in the Gray soil zone.
- Hybrid poplar relative spatial occurrence and estimated rate of C sequestration (Figure 2) could be used as a guideline for identifying best locations for future planting.
- Best predicted areas for future planting are the Gray, Brown, and Dark Brown soil zones, where on the majority of the clusters, the C sequestration rate is estimated >6.3 Mg C Km^{-1} yr^{-1}, ranging 4.62–7.27 Mg C Km^{-1} yr^{-1}.
- Planting fast growing hybrid poplar shelterbelt trees on agricultural landscapes is an important strategy for mitigating greenhouse gasses.
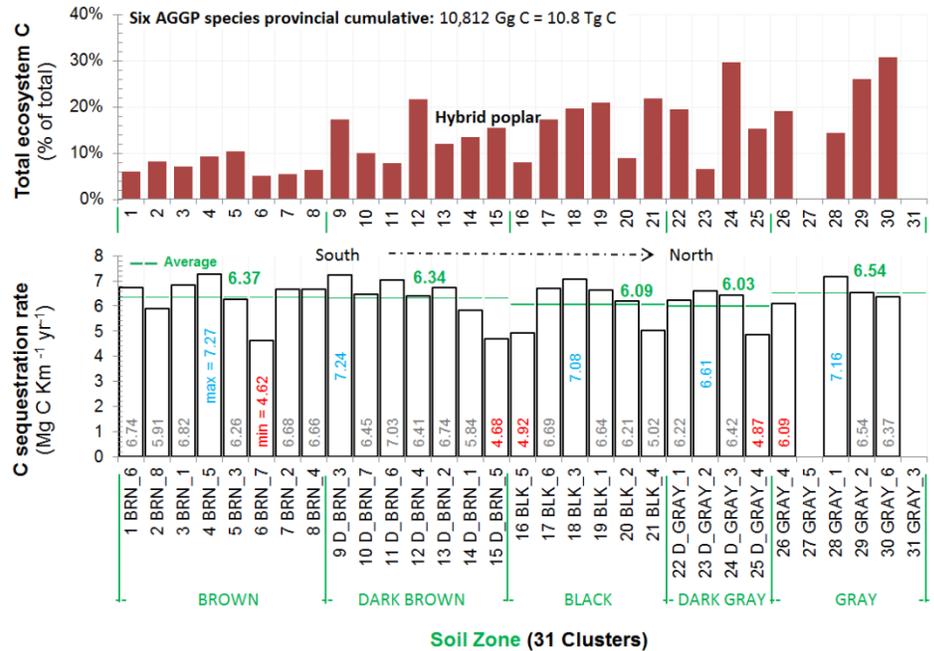

Figure 2. Relative spatial occurrence (top) and C sequestration rate of hybrid poplar shelterbelts across 31 clusters and 5 soil zones in Saskatchewan.

FURTHER READING

Amichev, B.Y., et al. 2016. **Carbon sequestration by planted shelterbelts in Saskatchewan: 3PG and CBM-CFS3 model simulations.** *Ecological Modelling* 325:35–46

AGGP Fact Sheet(s): **SASK-1, SASK-2, SASK-5, SASK-10**

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