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CARAGANA GROWTH AND CARBON STOCKS IN SHELTERBELTS IN SASKATCHEWAN

by BEYHAN Y. AMICHEV

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 multi-stem caragana shrub 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 caragana growth in shelterbelts: mean aboveground biomass (stems, branches, bark), at age 60 years, was 93–147 Mg Km⁻¹, plant diameter at 30 cm height was 30–36 cm, and the height of tallest stem was 8–9 m (Figure 1). The growth curves were used in the CBM-CFS3 model to produce an inventory of the carbon stocks (Table 1) in all caragana shrub shelterbelts planted from 1925 to 2009.

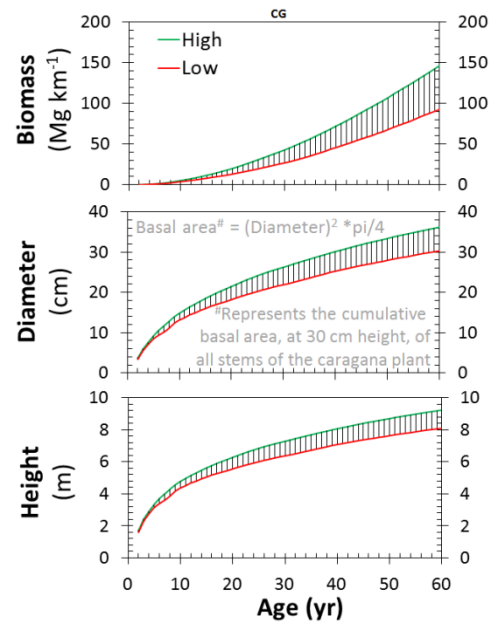


Figure 1. Caragana growth in shelterbelts: range of biomass, plant diameter, and height.

CARBON STOCKS INVENTORY

- TEC stocks and C stocks additions in caragana shelterbelts were 7.9 and 3.4 Tg (1 Tg = 1 million Mg), respectively. About 77% of these C stocks additions (2.6 Tg) occurred since 1990, regardless of the planting period, and have an estimated value of \$144 million, at \$15 per Mg CO₂-eq (Table 1).
- 20% (7,053 Km) of all caragana shrub shelterbelts (35,245 Km) were planted in the last 25 years.
- For six common shelterbelt species in Saskatchewan, the total length of caragana shelterbelts is 70%, and the TEC stocks stored in them is 73%, of the cumulative length and TEC stocks, respectively.
- Although 76% are in the Dark Brown soil zone (Table 1), caragana shrub shelterbelts represent about 20–70% of the cumulative TEC stocks in the Black soil zone. In the Brown soil zone, they have spatial occurrence up to 90% in some clusters, and are consistently >75% across all clusters (Figure 2).

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

Soil zone	Caragana shelterbelts planted 1925-2009				Length Km
	Total Ecosystem C		C Additions		
	Since 1925	Since 1990	Since 1925	Since 1990	
Gray	469	348	275	275	46
Dark Gray	29,908	14,005	12,283	9,905	455
Black	389,388	157,518	156,030	115,557	995
Dark Brown	4,296,918	1,948,077	1,753,596	1,335,925	26,768
Brown	3,147,355	1,592,972	1,481,728	1,155,526	6,981
Totals (Mg C):	7,864,038	3,712,920	3,403,911	2,617,188	35,245
(Tg C =)	7.864	3.713	3.404	2.617	



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RELATIVE OCCURRENCE AND C SEQUESTRATION RATE

- Caragana growth, ability to resprout quickly, and its C sequestration potential make it a very desirable species for shelterbelt establishment (Figure 2).
- The average C sequestration rate was 1.73–2.03 Mg C Km⁻¹ yr⁻¹, the highest being in the Gray soil zone.
- Caragana 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 Brown and Gray soil zones, where on the majority of the clusters, the C sequestration rate is estimated >2.00 Mg C Km⁻¹ yr⁻¹, ranging 1.41–2.53 Mg C Km⁻¹ yr⁻¹.
- Planting caragana shrub shelterbelts on agricultural landscapes is an important strategy for mitigating greenhouse gasses.

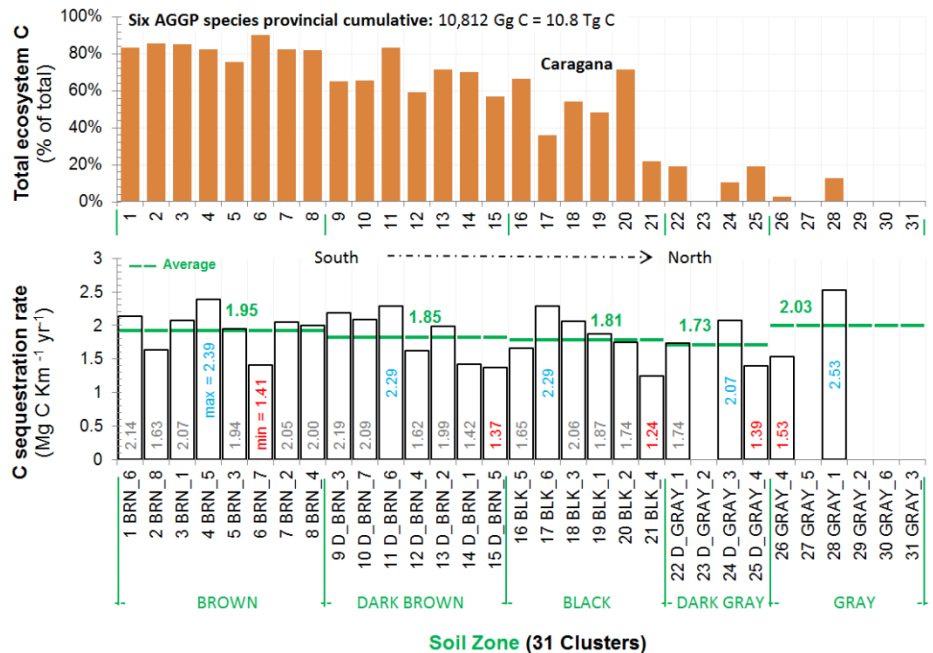


Figure 2. Relative spatial occurrence (top) and C sequestration rate of caragana shelterbelts across 31 clusters and 5 soil zones in Saskatchewan.

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-9, SASK-10

CONTACT FOR MORE INFORMATION: SASKAGROFORESTRY.CA/

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