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TREE AND SHRUB GROWTH COMPARISON IN SHELTERBELTS IN SASKATCHEWAN

No. SASK-2

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Tree and shrub growth predictions with the 3PG model are based on species-specific properties and variables. For each variable, a parameter value was assigned that would best represent the growth and development of trees and shrubs in shelterbelt rows. Four methods of variable parameterization are used: 1) field data from sampled shelterbelts in our study; 2) data from the literature; 3) default 3PG model parameters; and 4) finally, we applied a multiple iteration approach so that a best fit was reached between 3PG model predictions and the field data for tree height and diameter. The parametrized 3PG model was used to generate growth curves for six common shelterbelt species (Figure 1).

Biomass growth (stem, branches, and bark) in shelterbelts, age 60 years, ranged 139-593 Mg km^{-1} in hybrid poplar (HP) > white spruce (WS) > Scots pine (SP) > Manitoba maple (MM) > caragana (CG) > green ash shelterbelts (in descending order). Diameter, at breast height (DBH) or at 30 cm height (for caragana), ranged 30-61 cm, and height ranged 9-17 m (Figure 1). The fastest growing trees, in terms of tree height (at age 10 years) were HP (10 m) and SP (6 m), and the slowest growing trees were GA and WS, both at 4 m.

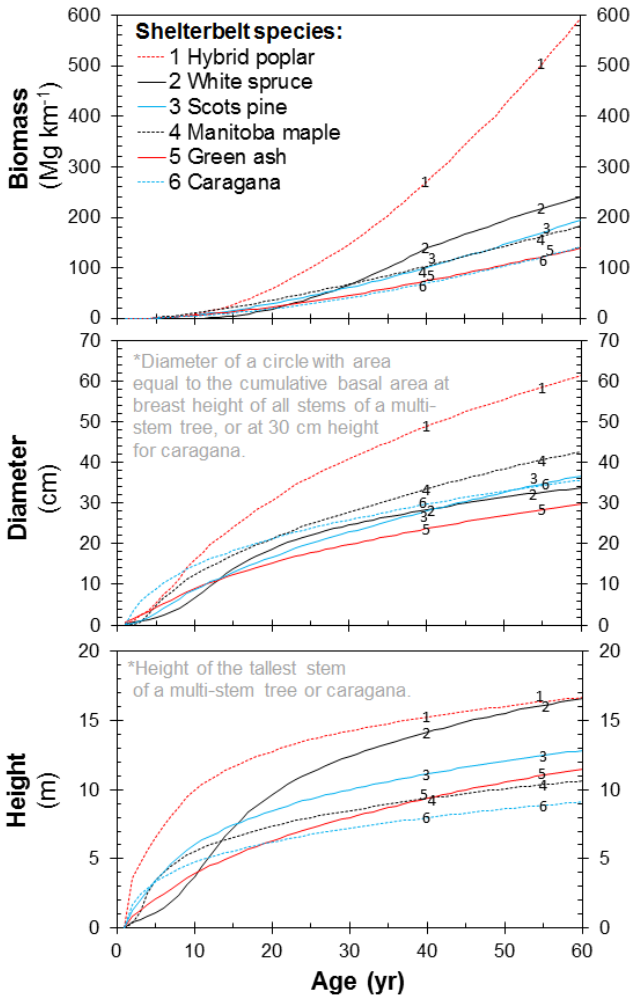

Figure 1. Growth curves of six common shelterbelt species in Saskatchewan.

BIOMASS ALLOMETRIC EQUATIONS

- Allometric equations (Table 1) for six common shelterbelt species were based on tree biomass, tree spacing, tree mortality, height, and diameter data.
- Detailed field data were collected by destructively sampling randomly selected trees in shelterbelts across Saskatchewan (Figure 2).
- The r^2 ranged 28-97% in WS>HP>SP>GA>MM>CG shelterbelts. RMSE was <48% and bias was <30%.

Table 1. Biomass equations of six common shelterbelt species in Saskatchewan. Accuracy of the equations was evaluated by percent r^2 of observed versus predicted values, percent root mean square error (RMSE), and bias (negative bias indicates overestimation).

Species	*Biomass (Kg) = **a** * (Diameter, cm)^b*				
	a	b	r^2(%)	RMSE(%)	Bias(%)
Hybrid poplar	0.091417	2.3011	84	39	-16
White spruce	0.006603	3.1832	97	22	27
Scots pine	0.432635	1.8870	74	19	1
Manitoba maple	0.294275	1.8980	66	32	-9
Green ash	0.206365	2.1217	71	48	-0.3
Caragana	0.028397	2.5760	28	40	-7

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GROWTH OF SHELTERBELT TREES AND SHRUBS

- Diameters of sampled trees ranged 1–59 cm.
- Shelterbelt biomass equations (Table 1) and curves (Figure 2) can be used by land owners to estimate biomass from DBH data and to determine relative tree growth.
- It takes 20 (for HP) to 60 (for GA) years of growth for shelterbelt trees to grow to 30-cm DBH (Figure 1), and biomass ranging 199–332 Kg tree^{-1} for WS > GA > SP = HP > MM trees (Figure 2).

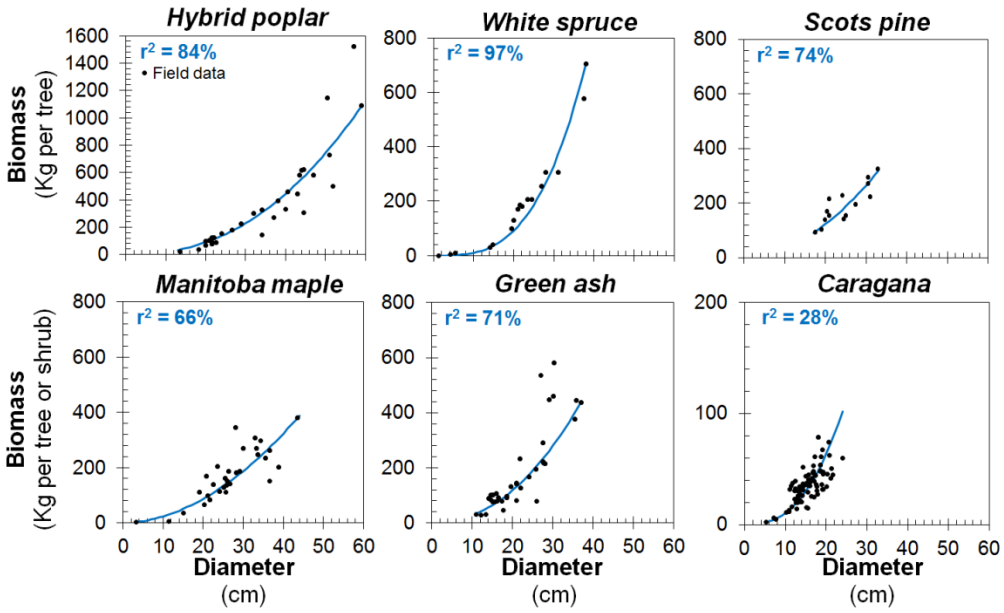

Figure 2. Biomass as a function of diameter for six common shelterbelt species in Saskatchewan. Field data (black dots) represent randomly selected, individual, destructively-sampled trees and shrubs. R^2 (%) evaluates the equations used to create the biomass curves for each species.

- The 3PG model is a valuable modeling tool for shelterbelt biomass estimation, performance evaluation, and decision support systems for future tree planting on agricultural landscapes.

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-3, SASK-10**

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ACKNOWLEDGEMENTS & COPYRIGHT

This research was done by a team of collaborators from the University of Saskatchewan, University of Regina, and Agriculture and Agri-Food Canada (AAFC), under the leadership of Dr. Ken Van Rees of the University of Saskatchewan. Funding was provided by Agriculture and Agri-Food Canada (AAFC)'s Agricultural Greenhouse Gases Program (AGGP). We thank the AAFC Agroforestry Development Centre at Indian Head, SK for providing the shelterbelt tree data. This fact sheet was completed in May 2016.