Carbon Forestry Options using Exotic Larches in Northern New England

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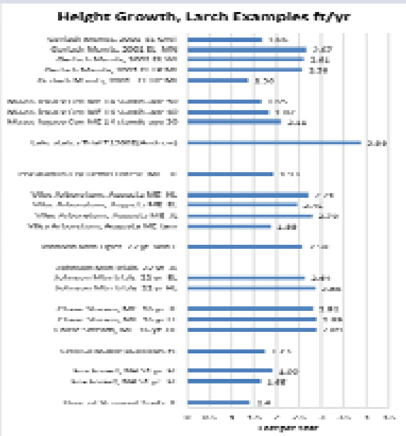
INTRODUCTION

Exotic European (*L. decidua*), Japanese (*L. kaempferi*) and Dahurian larches (*L. gmelinii*), and their hybrids, have been planted in numerous small trials and operational plantings in this region. Estimated volume growth rates far exceed what is obtained by native conifers. Stands can reach small sawlog sizes in 16-20 years. In one instance a stand was harvested commercially at age 13. Documented results show that, with only basic management, planted larches can offer another option for carbon forestry in this region. The volume grown can be used for long-lived wood products instead of paper or energy as is expected with other short-rotation intensive culture (SRIC) species being studied in the Northeast. We compare estimated carbon storage results in a 60 year management period using these larches. We assess these against relevant benchmarks. Forest plantations offer only limited leverage on the regional carbon budget, but we believe larches deserve consideration as one option. Finally, larch leaf litter is nutrient rich and the species can be used in a variety of silvicultural roles. In terms of climate change, larch has other benefits as well; for example, because it loses its needles, the albedo (reflectance) of larch stands is much higher in the winter particularly when the ground is snow covered.

Left: Planted larch on Giffen property (25 years-old, 80 ft tall). Right: Bengt Anderson – Gul with 2 year-old planted hybrid larch. Both photos in Central Maine.

DOCUMENTED LARCH HEIGHT GROWTH RATES

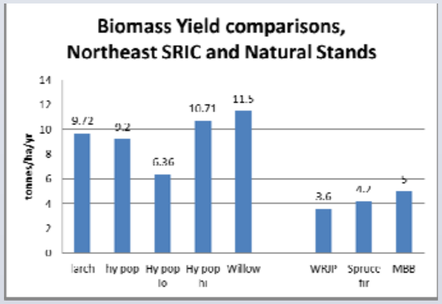
In northern New England, we have collected 7 stands aged between 30 and 75 years. They are between 73 feet and 105 feet in height (growing 1.4 to 2.1 feet per year). Seven other stands of exotic larches were between 22 to 24 years old; these grew in diameter at an average of 0.43 inches per year and reached heights between 45 and 67 feet (1.9 to 2.8 feet per year).



Dan Simonds in 14 year old larch plantation, Western Maine. Photo by David Maass.

SILVICULTURAL USES OF LARCHES

I. Nurse crops for pines, oaks and other hardwoods
II. Mix with white pine to reduce weevil damage (has been tried, not carefully evaluated)
III. Fast growing hedges or snow fences
IV. Fast growing stands for small roundwood items such as posts
V. Rapid growth for lumber
VI. Tonnage Growth rates competitive with SRIC examples in region, but gives end use options other than biomass
VII. Short rotations offer flexibility for unexpected climate changes, market shifts, or other concerns.
VIII. Larch leaf litter is high in nutrient content, offering benefits to soil rehabilitation.
IX. Watershed plantings along reservoir banks.



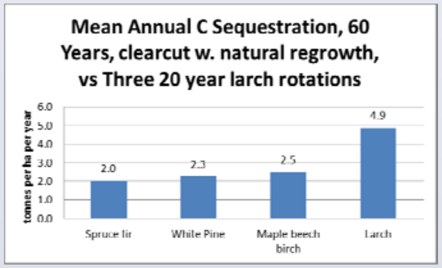
Left: Short Rotation Intensive Culture (SRIC) examples. Right, natural stands from 60 yr rotations, GTR NE 343.

NATURAL REGROWTH VERSUS PLANTATION

In USFS Gen. Tech Report NE-343, the analysts supplied FIA-based estimates for carbon sequestration in natural stands following clearcutting. These were to be used as default values in estimating carbon storage in natural stands. Comparing these with measurements by Gerlach of a sample of stands over the Northeast shows that when larches are planted over 3 successive rotations, annual storage can be almost four times as high. This omits counting the multiple rootstocks left behind each time the larch is cut, and does not include carbon stored in solid wood products manufactured for any of the species, or the substitution benefits of using wood rather than other materials (Matthews 2014).

LARCHES, CARBON CYCLE, AND CLIMATE

I. If planting is considered a Carbon storage option, larch's annual sequestration rates far exceed other conifers.
II. High yields have been observed across North-South range of New England, giving larches a potential role in adaptive management
III. Early yields for solid products enable C storage as wood in use.
IV. Potentially short rotations offer maximum flexibility to adapt to changing circumstances, compared to natural regrowth of natural stands.
V. Repeated replanting results in additional rootstocks being created after every replanting.
VI. The opportunity for income in the 15-20 year age range can significantly reduce the financial cost of C storage compared to other planted species.
VII. The Albedo of larch stands is higher than other conifers with snow on ground.
VIII. The GHG benefits of substituting wood for other materials are significant; larch offers this option where SRIC approaches do not.



CONCLUSIONS

I. The oft cited view that the best way to store carbon is to let stands grow forever is a misconception. The best way is to substitute wood for other materials.
II. For short rotations, larches offer annual average yields that are competitive with those measured for hardwood SRIC species.
III. Over a 60 year period, a comparison of 3 successive larch rotations shows that the planted stands can sustain carbon MAI's that are almost 4 times as high as natural stands regenerating after clearcutting.
IV. The wood can be used, on a 20 year rotation, for solid wood products. For these comparisons we do not include carbon stored in wood, which would increase the difference. The substitution benefits can be substantial.
V. At any age beyond about 15 years, larch plantings can be cut with net revenue, yielding merchantable solid wood products, and replaced with some other planted species or allowed to regrow to natural vegetation. Naturally regenerating stands do not offer this option.

Larch has been used for a wide variety of products, worldwide, including:

Siding	Millwork	Bridge timbers and decking
Flooring	Hopyard poles	Wooden boat and canoe parts
Paneling	Decking	

REFERENCES

- Baltunis, B.S., M.S. Greenwood, and T. Eysteinsson 1998. Hybrid vigor in Larix: growth of intra- and interspecific hybrids of Larix decidua, L. laricina, and L. kaempferi after 5 years. Silvae genetica. 47: 288-293.
- Carter, K.K. and O. Selin, 1987. Larch plantation management in the Northeast. NJAF 4 : 18-20.
- Carter, K.K. and D. I. Maass. 1991. A forester's guide to larch in Eastern North America: an annotated bibliography. University of Maine, CFRU Info. Report 24. 47 pp.
- Gerlach, John. P. 2001. Comparison of productivity and related traits for European larch and red pibne across a site quality gradient in the Gret Lakes Region. MS thesis subm. To Michigan state University. 114 pp.
- Gilmore, D.W. and R., D Briggs. 1996. Empirical yield prediction equations for plantation-grown European larch in Maine. NJAF 13(1):37-40.
- Irland and Maass, 2016. Larch plantations in Southern New England: Curiosity or Opportunity? Connecticut Woodlands, Summer. Pp. 6-8.
- Johanson, T. 2012. Site index curves for young hybrid larch growing in former farmland in southern Sweden. Forests 3: 723-735 (2012).
- Kopp, et al. 1993. Willow biomass trials in Central New York State. Biomass and bioenergy 5, (2): 179-187.
- Larsson-Stern, M. Larch in Commercial Forestry: A Literature Review to Help Clarify the Potential of Hybrid Larch (Larix × eurolepis Henry) in Southern Sweden. Southern Swedish Forest Research Centre Alnarp, Sweden. 34pp.
- Li, R., Weiskittel, A.R., Kershaw Jr, J.A., Dick, A., Seymour, R.S. 2012. Regional stem taper equations for eleven conifer species in the Acadian Region of North America: Development and assessment. Northern Journal of Applied Forestry 29, 5-14.
- Maass, D. Exotic larch: not your grandfather's hackmatack. Northern Woodlands, Summer 2014.
- Mayer, C. and Curt Johnson.2010. Quantifying carbon sequestration in forest plantations. .in Stanturf, ed. Proc 14th annual southern silvicultural research conf. USDA FS GTR SRS 121, 614 pp.
- Sander, H. and A. Läänelaid. 2007. The Dunkeld larch (*Larix × marschlinsii* Coaz) in Estonia. Dendrobiology 57:73-80.
- Sanford, G. R. et al. 2016. Comparative productivity of alternative cellulosic bioenergy cropping systems in the North Central USA. Agriculture, Ecosystems and Environment 216 (2016) 344–355.
- Smith, James E. et al. 2005. Methods for calculating forest ecosystem and harvested Carbon. USDA- FS, Northeastern Research Station. GTR NE-343. 216 pp.
- Volk, T. A. et al. Yields of willow biomass crops across a range of sites in North America. Aspects of Applied Biology, 112, 2011. Biomass and energy crops.
- Michael B. Walters and John P. Gerlach, 2013. Intraspecific growth and functional leaf trait responses to natural soil resource gradients for conifer species with contrasting leaf habit Tree Physiology 33, 297–310.
- Winans , Kiara S. et al. Carbon sequestration potential and cost-benefit analysis of hybrid poplar, grain corn and hay cultivation in southern Quebec, Canada. Agroforestry Systems. June 2015, Volume 89, Issue 3, pp 421-433.

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