Using Phytotechnologies to Remediate Brownfields, Landfills, & Other Urban Areas

Ronald S. Zalesny Jr. & Jill A. Zalesny

U.S. Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, Rhinelander, WI 54501, USA

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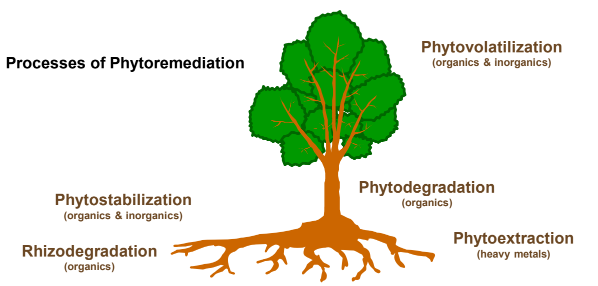
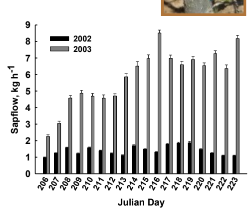
RATIONALE

Urban areas requiring remedial work has prompted the use of phytotechnologies to improve water quality, soil health, & biodiversity, as well as to achieve sustainable social & economic goals. Phytotechnologies directly use plants to clean up contaminated groundwater, soil, & sediment. An example of such technologies is phytoremediation, which is comprised of many processes.



While woody & herbaceous crops are candidates for such remediation systems, trees within the genera *Populus* (poplars, cottonwoods, aspens) & *Salix* (willows) are ideal given their elevated rates of photosynthesis and transpiration (A), fast growth (B), & extensive root systems (C). These trees are often known as "workhorses" towards remediation of contaminated areas. The genetic diversity within these genera substantially increases the establishment & growth potential across heterogeneous sites.

(A) Clone NM6, 4 & 5 yrs



Examples of phytoremediation projects conducted at the Institute for Applied Ecosystem Studies include:

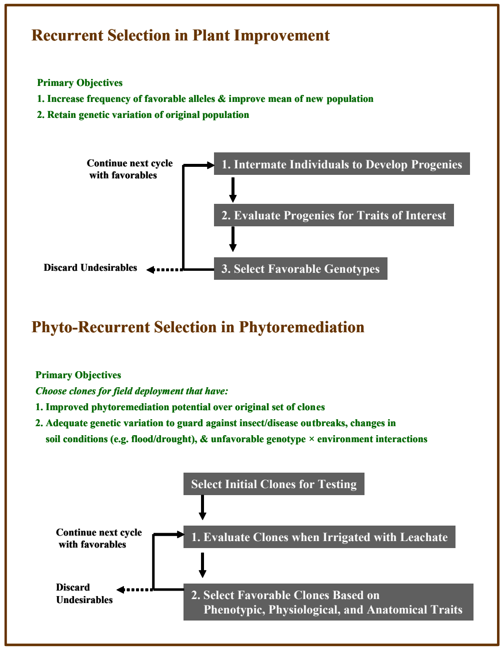
- Landfill leachate / effluent
- Municipal wastewater
- Papermill fibercake effluent
- Polychlorinated biphenyls (PCB's)
- Petroleum hydrocarbons
- Nitrates / fertilizer residues
- Ammonia
- Heavy metals
- Salts

(B) Clone NC14104, 14 months after planting.

(C) Clone NM6, 14 months after planting

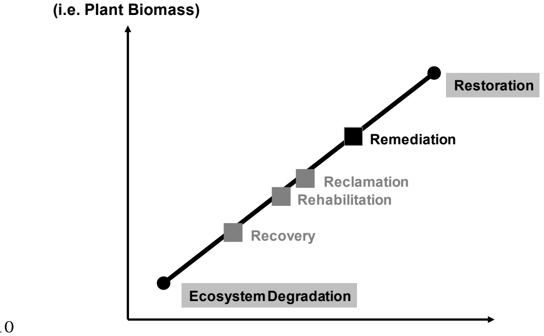
OBJECTIVES

We have tested these trees for more than a decade across various sites & contaminants, which has resulted in developing ***phyto-recurrent selection***, a method utilizing multiple testing cycles to evaluate, identify, & select favorable varieties with adequate genetic variation to guard against insect/disease outbreaks & changing edaphic conditions (especially those induced by contaminated soil & water) in the field. The figure below is an example for phytoremediation of landfill leachate.



REMEDIATION & RESTORATION

When moving towards remediation of contaminated sites, workhorse species are needed to achieve positive ecosystem function (i.e., plant biomass) while maintaining species diversity & complexity. Once remediation is successful, restoration is more likely to be attainable. These basic principles of the continuum between complete ecosystem degradation & pre-disturbance condition (i.e., restoration) are depicted below, with brownfields & landfills shown as examples that follow.



BROWNFIELDS

Abandoned or underused industrial & commercial facilities available for re-use, where expansion or redevelopment may be complicated by real or perceived environmental contaminations. Typically these sites are limited to reclamation, but remediation may be possible in some instances.

LANDFILLS

Typically remediation & restoration is possible on these sites.

OTHER URBAN AREAS

Examples includes railyards, shipyards, & harbors.

PRACTICAL IMPLICATIONS

Cost-effective phytotechnologies are available to assist researchers, resource managers, regulators, etc. to improve environmental conditions while protecting human health.

Phyto-recurrent selection can help researchers & resource managers move closer to obtaining long-term (i.e., rotation age) remediation data from brownfields, landfills, & other urban areas.

Well-developed experimental designs & associated precision levels support estimation of quantitative genetic data that lead to recommendations of generalist genotypes that perform well over broad contaminant ranges or specialist genotypes that perform well for specific contaminants.

This effort supports scientists & resource managers to acquire information that contributes to the deployment of phytotechnologies that are ecologically & economically more sustainable versus traditional systems, while the general public maintains environmental quality & protection of the natural resource base on which local & regional recreation, agriculture, & forestry depend.

ACKNOWLEDGMENTS

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