Sea buckthorn in the *FORESTSPECs* Project: production of bark based composts for soil improvement on the European North of Russia

Natalia Demidova

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- **“Wood Bark and Peat as Raw Materials for Bioactive Compounds and Specialty Chemicals: from Innovations to Applications” (*“ForestSpeCs”*).**
- 2009-2011.
- The project is funded by the European Union’s Seventh Framework Programme (FP7).

Partners

- University of Helsinki, Finland;
- Technical Research Centre of Finland, Finland;
- St Petersburg State Medical Academy, Russia;
- University of Surrey, UK;
- Northern Research Institute of Forestry, Russia;
- Far East Forestry Research Institute, Russia;
- Research Institute for Organic Agriculture, Switzerland;
- Trifolio-M, Germany; Oy Granula Ab Ltd, Finland.

The aim of *FORESTSPECS* project

- To utilize different types of wood residues from the wood processing industry such as bark of various species (*Betula*, *Pinus*, *Picea*, *Larix*, *Abies* and *Populus)*, as well as peat, as a raw material to produce bioactive compounds and environmentally benign industrial chemicals and polymers as well as remediation materials.

Typical processes applied in the project:

- separation of bioactive fractions and compounds either by extraction or distillation to obtain a variety of products with potential use in pharmaceutical, cosmetic and pest management applications;
- chemical, biochemical, or biotechnical modification and tailoring of the primary products obtained, according to the needs of chosen applications;

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- development of new, innovative ways of using the materials remaining after extraction for example in environmental remediation.
- The project is also exploring the possibility of using wood bark from the pulp and paper industry, as organic fertilizers in horticulture and in reforestation.

- All the raw materials used in the *FORESTSPECS* project are produced in high volumes within the EU and Russia.
- However, the possibilities of using bark as a raw material for bioactive compounds, speciality chemicals, or for remediation, have gained only moderate attention in comparison with using bark as a marginal and small-scale energy source.

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- Wood bark can be used as raw material for remediation of poor or contaminated soils.
- Poor soils deficient of organic matter and nutrients affect the lives of hundreds of millions of people all over the world: as in northern climates as well as in arid areas threatened by desertification.

- The process of soil remediation will need huge amounts of organic matter from renewable sources – waste materials such as bark from forest industry can play a key role in providing such inputs.
- *FORESTSPECS* study the processing and suitability of bark waste and related materials for these purposes.

- The agricultural land occupies 1.8% (728000 ha) and forests 55.8% of the land area of the Arkhangelsk Region.
- 74% of that agricultural land is affected by negative processes (erosion, swamping, salinization, etc.), and soil remediation is progressing slowly.
- Composting of chipped wood-related residues was used for vegetable cultivation and reforestation in the 1960's.

- There are 5 mil. m^3 of wood waste produced annually in the Arkhangelsk Region,
- Only 2 mil. m^3 are under utilization, which is mainly used as a low-value energy supplement (According to data of the Ministry of Natural Resources and Forest Industry of Arkhangelsk Region).

- In *FORESTSPECS* we are studying the suitable processes, usually via ‘designer composting’, to produce suitable materials for different applications.
- Technology of non-traditional organic fertilizers on the bases of wood-related residues is used for compost production, based on birch and spruce bark, chicken manure and *Trichoderma* in different proportions.

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- A specific case study is to be examined in a long-term field experiment of the potential of forest soil improvement for sea buckthorn fruit production.
- Sea buckthorn plants growth, survival, yield, and fruit quality will be studied and compared between the different treatments.

- Sea buckthorn introduction in the Russian North started in 1969 in the Dendrological Garden of Northern Research Institute of Forestry.
- The results of the introduction test approved successful SBT removal to the European North of Russia.
- It fruits regularly and abundantly under the conditions of Arkhangelsk and forms fruits of normal size and quality.

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- Plants of its existing varieties, developed in the climatic conditions of other areas of the country, suffer in the North from being frosted over.
- Because of the unfavorable combination of weather conditions (wet autumn, high snow cover, winter thaws) mortality due to root system damping-out is high.

Arkhangelsk Region

- The Russian European North.
- The experimental plot: 64^0 33` north, 39° 40` east.
- The climate is maritime, subarctic.
- Average annual temperature of the air is +0,8°C.
- The average temperature of January is -12,5^0 C, July is +15,6^0 ? .
- An absolute annual minimum of temperature of the air is -49°C.

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- The average quantity of precipitation on a long-term data is 675 mm in a year, including summer months with 203 mm.
- The average duration of the vegetation period is about 136 days.
- Effective temperature is 920^0 C.
- Stable snow cover is formed in November and reaches the maximum value in March.

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- The climate is characterized of frequent changes of the air mass.
- The arctic cold air invades every summer months and brings frosts during the vegetation period.
- Frequent thaws are observed in winter.
- Poor podzole soils.

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- Period of shoots' growth is one of the major periods during vegetation.
- An annual shoot growth in length can be reasonably effectively used for the forecast of plants frost tolerance.
- It was established, that with annual shoots length growth dynamics (namely, in due to termination of their intensive growth) there is in invert correlation to a degree of their freezing at wintering.

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- Observations have shown that sea buckthorn shoots of young plants are in a condition of growth before autumn colds come and, as a rule, do not form terminal buds.
- Annual shoots usually grow up to a moment of return transition of the daily mean temperature of air through + 5^0C.
- It was found out that together with shoots growth termination the speed of their growth in length differs during season.

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- The most distinctions are in dates of increase growth of the main part of annual shoots' length.
- SBT plants winter hardiness differ by intensive and short period of growth that testifies sufficient preparation them to wintering.

- On the basis of long-term SBT phenological observations, average dates of main phases of seasonal development, phenological period duration and their provision by warm were determined.
- It has been considered, that a sum of daily average temperatures above $+5^0$C about 235°C is needed for the beginning of SBT flowering.

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- During the *FORESTSPECS* project we will develop recommendations on preparation and application of non-traditional organic fertilizers based on wood bark for fruit-berry plants cultivation in northern conditions.

Composting experiments in Arkhangelsk

- 10 pieces of “L&T Bio-240” composters;
- Birch and spruce bark;
- *Trichoderma*;
- Dry chicken manure.
- Mixing of the composts was provided once a week.
- Addition of chicken manure and *Trichoderma* will continue during winter time according to requirements.

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Composting experiments

Shredded *Spruce* bark (SSB)	Shredded *Birch* bark (SBB)
Composter Nr. 1 a). SSB (220 L) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week; f). + 5% Chicken manure+10 L of water after 2 weeks. **Without isolation**	**Composter Nr. 2** a). SBB (220 L) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week;). + 5% Chicken manure+10 L of water after 2 weeks. **Without isolation**

Composter Nr. 3	Composter Nr. 4
a). SSB (220 L) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week; f). + 5% Chicken manure+10 L of water after 2 weeks. **With isolation**	a). SBB (220 L) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week;). + 5% Chicken manure+10 L of water after 2 weeks. **With isolation**

Composter Nr. 5	Composter Nr. 6
SSB (225 L) + Tr (180 g) + 15 L of water; **With isolation**	SBB (225 L) + Tr (180 g) + 15 L of water; **With isolation**

Composter Nr. 7	Composter Nr. 8
a).SSB (220 L) + Tr (180 g) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week; f). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks. **Without isolation**	SBB ((220 L) + Tr (180 g) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week; f). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks. **Without isolation**

Composter Nr. 9	Composter Nr. 10
a).SSB (220 L) + Tr (180 g) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week; f). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks. **With isolation**	SBB ((220 L) + Tr (180 g) + 5% Chicken manure + 15 L of water; b). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks; c). + 10 L of water after 1 week; d). + 5 L of water after 1 week; f). + 5% Chicken manure+ Tr (180 g)+ 10 L of water after 2 weeks. **With isolation**

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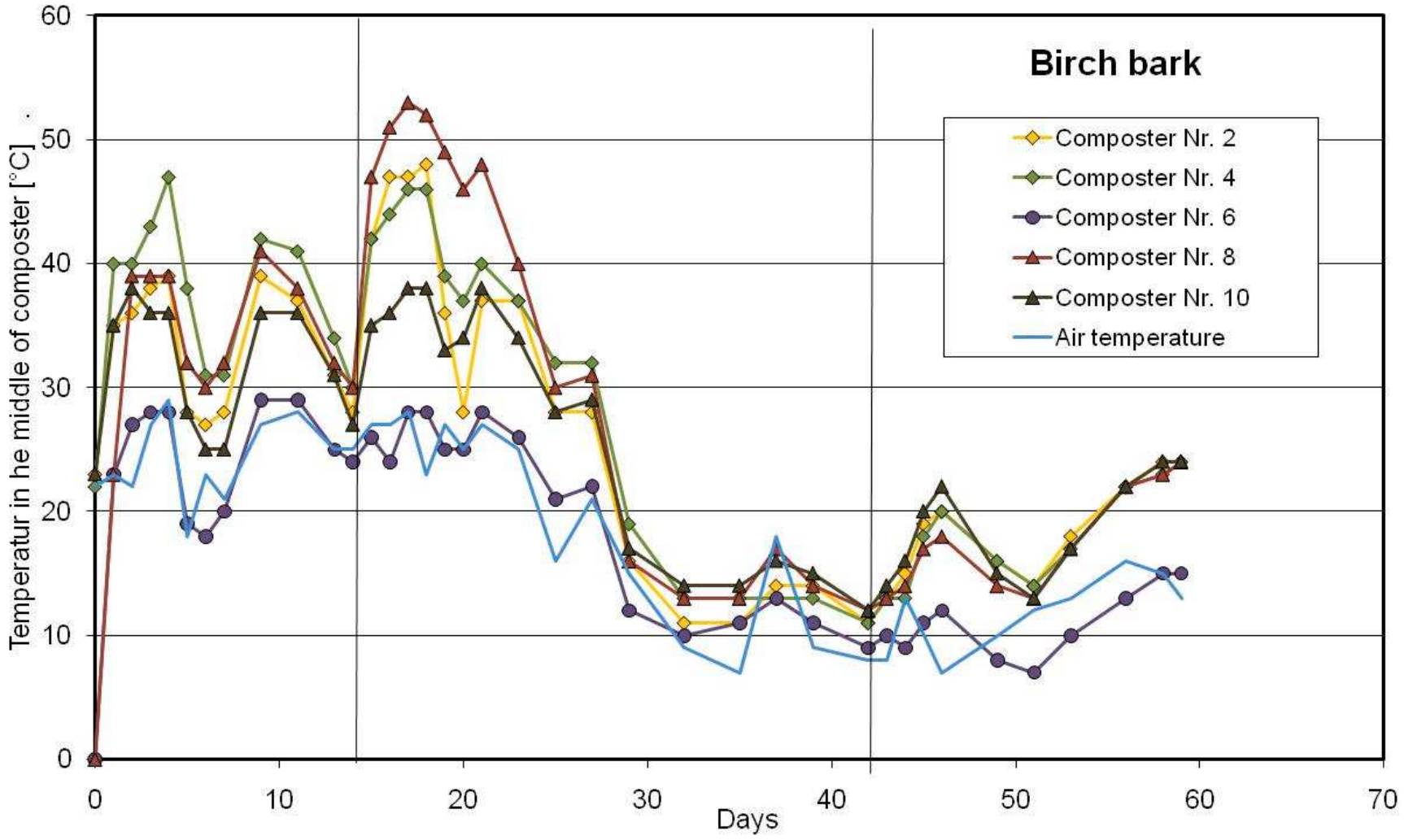
Temperature measurements

Temperature evolution during composting

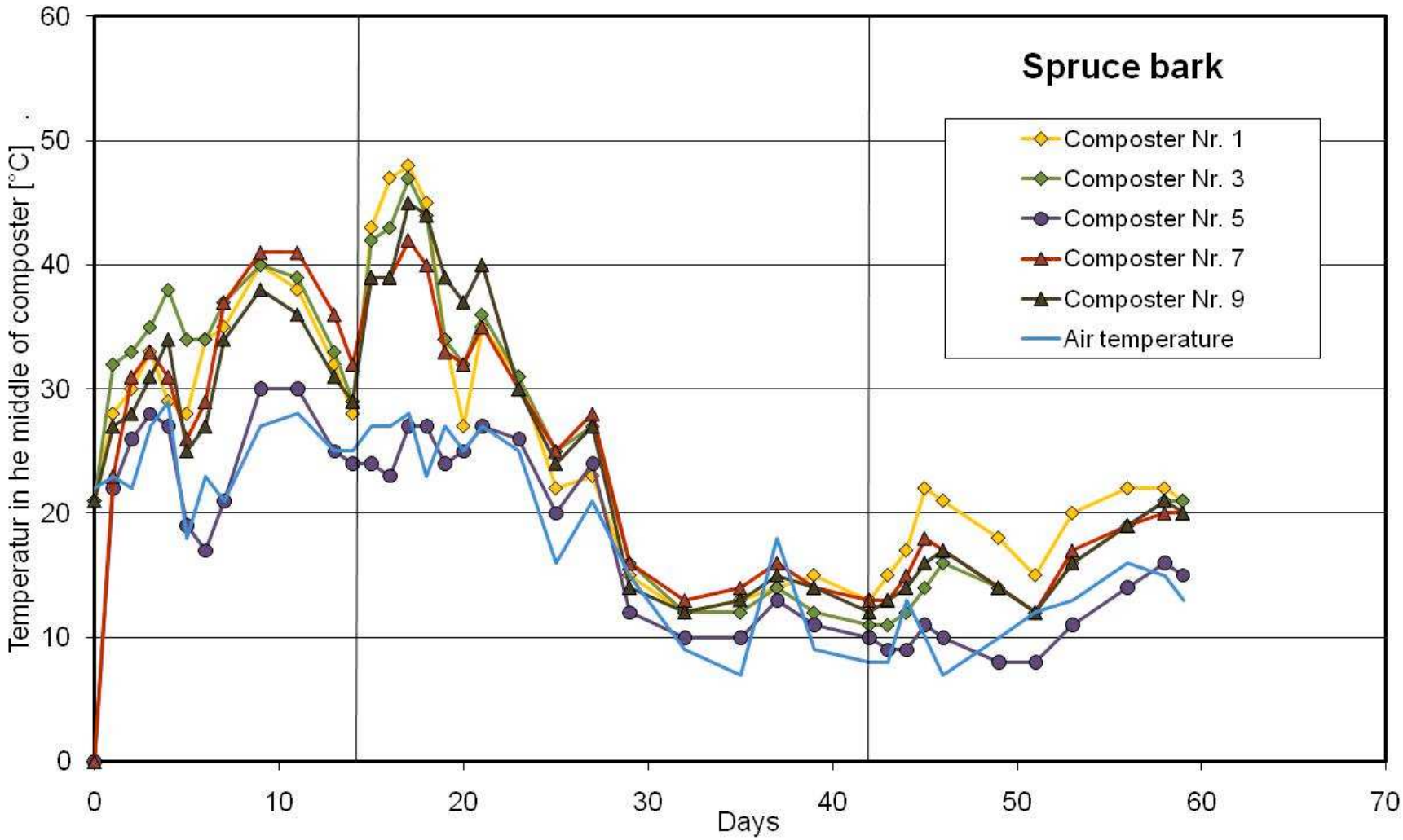


2-month old compost (20.09.2010)

Birch bark + Tr

Birch bark + Tr + Chicken manure

Temperature evolution during composting



2-month old compost (20.09.2010)

Spruce bark + Tr

Spruce bark + Tr + Chicken manure

- Chemical analyses of the compost prepared in Arkhangelsk were done by Jacques Fuchs (Research Institute for Organic Agriculture (FiBL), Switzerland).
- The aim of the analyses is primary to know approximately the content of mineralized nitrogen in the composters, to know if a supply of manure should be necessary or not.

Soil improvement

- 21 fruiting sea buckthorn plants (*Hippophae rhamnoides*).
- Ready-made bark compost: spruce bark+ caw manure was used under fruiting plants in the amount of 160 L/plant.

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Sea buckthorn fruits (*Hippophae rhamnoides*)

? plant	Weight of 100 fruits, g		Weight of 10 biggest fruits, g	
	2009	2010	2009	2010
37-89-321	90,2	99,3	12,2	13,5
32-90-434	80,9	112,9	10,2	13,4

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Influence of bark compost on shoot growth.

Thank you for your attention!

- Phone +7 (8182) 61 26 79
- Mob. +7 921 495 95 13
- Fax: +7 (8182) 61 25 78
- E-mail: forestry@ptl-arh.ru
- www.
  http://www.forestspecs.eu/