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Is biomass production consistent with tree retardation of explosives on former military sites?

B. Schoenmuth[1], T. Scharnhorst[1], D. Schenke[2], C. Büttner[1]

1) Humboldt University of Berlin, Section Phytomedicine, Lentzeallee 55/57, D-14195 Berlin

2) Julius Kuehn Institute – Federal Research Institute for Cultivated Plants, Koenigin-Luise-Str. 19, D-14195 Berlin

E-mail: **berndschoenmuth@yahoo.de** Web: **www.DendroRemediation.de**

Initial situation: Large military areas are still „unutilised“!

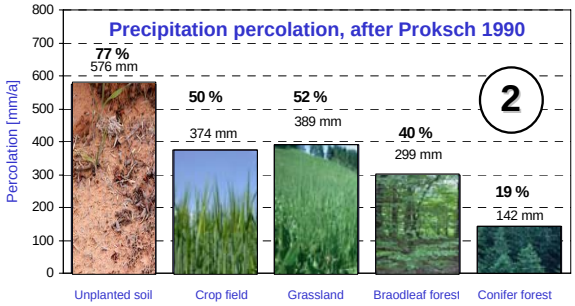
Former ammunition sites are of special interest as potential biomass production sites because of the large extent of these areas (**2,8% of the entire area in Germany**). In the state of Brandenburg with approx. 2 000 square kilometres even seven percent of the land's areas are former and currently used military areas. To a considerable extent the soils in these areas are suspected to be contaminated with explosive specific substances like **TNT** (2,4,6-trinitrotoluene) or **RDX** (Royal Demolition eXplosive). Soil leaching of explosives by precipitation is endangering ground water ressources and residues of munitions are restricting the site usability. To a greater extent these military sites are covered with woodlands, mainly with conifer stands.

Prior-ranking of soil protection!

Resource utilisation concepts for explosive contaminated areas regarding biomass production have to maintain the pollutant retardation and **Natural Attenuation potential of the vegetation** (Fig. 5).

Avoid soil tillage operations!

Soil cultivation should be held on a **minimum level** because it dramatically enhances remobilisation of soil explosives. Therefore, „agro-forestry“ is not recommended here.



Explosive leaching is lowest beneath conifer forests!

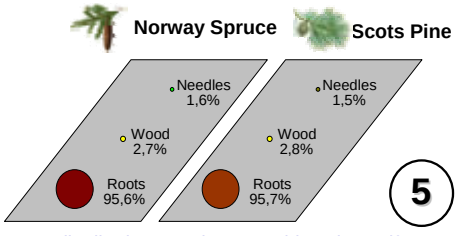
Underneath conifer forests percolation of rainfall and snow water is substantially lower than beneath deciduous forests, or agronomic crops or grassland.

Caused by winter transpiration and crown interception, thus, indirect retardation of soil pollutants is the highest beneath conifer stands (Fig. 2).

Fast-growing willows, Julius Kuehn-Institute, Berlin

Conifer roots „detoxify“ TNT!

Pines and spruces, respectively do not only accumulate TNT in their roots. Moreover, TNT becomes readily transformed and at least 90% of TNT derivatives are long-lasting metabolically bound in cell wall components like lignin and hemicelluloses.
Neither TNT nor known TNT metabolites are (radio-analytical) detectable.



Mass distribution TNT borne residues in conifer trees

Only tolerant plants deliver biomass yield!

Field grown energy plants and fast-growing agro-forestry trees, like willow (Fig. 3) and poplar are less tolerant to degraded soils and explosive contaminations than coniferous trees (Fig. 4) and therefore they are inefficiently for biomass production on degraded areas.

Pines tolerate climatic change!

Coniferous trees like Scots pine allow less percolation of precipitation water (Fig. 2) and **tolerate expected summer dryness** much better than broadleaf trees do, as they already had been proven during summer drought in 2003.

Competition of protection goals!

(Conflict potential)

Reinforced planting of trees is considered as an effective measure for CO2 fixation (BMU). Indirect pollutant retardation (Fig. 2) and accumulation of detoxified explosives in trees (Fig. 5) considerably contribute to **soil and ground water protection** goals and serve as elements of **sustainable land use.**

Biomass production is conflicting with biodiversity loss by the **decline of open landscapes**, bearing valuable habitats for drought resistant plants and thermophilic animal species.

Scots pine forest on sandy soil, State of Brandenburg

Research requirements!

The **knowledge** basis in literature for a holistic contemplation of the long-term fate of explosive compounds in trees is considered as **insufficient** to deliver resilient information for the forester.

Trees themselves can apparently mineralise explosives only to a low extent in a direct manner. First results for possibilities of an **indirect mineralisation of explosives** during rot processes of dead conifer residues (e.g. roots or needles) are waiting to be balanced in a long-term scale.

For leaf-bearing main forest trees (e.g. beech, oak, maple) any **information** regarding uptake and transformation of explosives **is still lacking**.