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Phytomanagement of contaminated sites to produce biomass for bioenergy and biomaterials

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Abstract

Demographic estimates project that world population will rise to 9 billion by 2050 and level off between 9 and 12 billion people by the end of the century. As a result, global crop demand is expected to increase by 100 –110 % from 2005 to 2050. However, the potential to expand the area available for arable farming is limited. Demand for land to produce food, fodder and fiber, and accommodate housing will increasingly compete with the demand of bio-based products and bioenergy. Contaminated land is an extensive underutilized resource, which could -and should- be used in a sustainable way to grow plants for a large variety of profitable purposes. Phytoremediation is the non-invasive technology of using green plants to remove contaminants from the environment or to render them harmless. The two main sub-technologies of phytoremediation are:

•Phytoextraction: plants remove metals from the soil and concentrate them into their harvestable parts.

•Phytostabilization: plants reduce the mobility and bioavailability of contaminants in the environment either by immobilization or by prevention of migration.

A new and more recent aspect of phytoremediation is phytomanagement in which remediation strategies are combined with sustainable and profitable site management options, resulting in a net gain in soil functions and ecosystem services, while producing economic revenue. In order to ensure sustainable phytomanagement applications, suitable fast growing, high biomass-yielding and value-added crops are needed that can be used as feedstock for a wide range of products with different applications on industrial cale (e.g. biomaterials, bio-lubricants, bioplastics, pulp for paper, biochemicals, biofuels, biochar, etc). Promising plant candidates are several industrial non-food crops since they do not enter the food chain and they can produce raw materials with a relevant economic value. Examples of such suitable crops are: flax, kenaf, hemp, miscanthus, switchgrass, giant reed, reed canary grass, castor, cardoon, willow, poplar, oak, eucalyptus, etc.

The main driving forces for the use of industrial non-food crops in phytomanagement applications are:

• Economic: Most of these crops are multipurpose, offering the opportunity to follow a cascading biorefinery concept and produce a number of value-added bio-based products and bioenergy. The cultivation of these crops will increase and diversify farmers' income through access to new markets (bulk and fine chemicals, biomaterials, bioenergy, etc.), will create new jobs and will stimulate the innovative entrepreneurship.

• Rural renaissance: the sustainable growth in rural areas will be fostered by providing new market opportunities and business models, enabling rural communities to develop sustainable value chains.

• Environmental: cultivating contaminated soils with industrial non-food crops will support the reduction of desertification and floods by increasing vegetation cover and thus reducing erosion and surface runoffs, decreasing contaminant transportation to other clean areas, reducing leaching to the groundwater, and will increase the soil organic matter and carbon sequestration.

Keywords: risk assessment, conventional agriculture, organic agriculture, natural pesticides.

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