

**SUITABILITY OF ENERGY CROPPING
ON
ABANDONED METAL CONTAMINATED
FARMLAND**

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July 2012

Master of Engineering Science by Research

School of Civil, Environmental and Mining Engineering

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Abstract

A great deal of research is being undertaken globally on the viability of alternative energy sources given the potential effects of climate change and increases in oil prices. Energy cropping is one of many emerging technologies for producing renewable energy that is being widely researched around the world, and is in full-scale production in some countries. Abandoned contaminated land, awaiting remediation is another major global problem.

This masters thesis studies the potential re-use of abandoned metal contaminated land for growing 'energy crops' at a field site in China. Thus, with a potential to not only find an economical way to re-use and rehabilitate contaminated sites, but also to produce potentially 'carbon neutral' renewable sources of energy. The aim of this research is to examine the viability of growing different types of energy crops on metal contaminated land using chemical amendments.

This study has involved laboratory phytotoxicity tests, pot experiments and a field demonstration trial. The site selected for this project is located near Fuyang in Zhejiang province, People's Republic of China and is located adjacent to a former copper smelter. The four energy crops trialled at the field site are sweet sorghum, sugar cane, Chinese sumac and vetiver grass. Chinese sumac and sweet sorghum were also used in the pot experiments.

The methodology has involved trialling a combination of chemical treatments to immobilise the available metals in the soil in order to alleviate toxicity to the crops, along with the selection of locally available crop species which are tolerant to the soil conditions. The chemical treatments trialled included the addition of three different clay minerals (attapulgite, bentonite and zeolite), phosphate rock and lime.

The surface soils at the site are contaminated with metals (predominantly copper and zinc). All soils used in the laboratory experiments were from the site at Fuyang and were collected from the plot which has a high available copper concentration (2.63 mg/kg) (by sodium nitrate extraction) and a pH of approximately 6.1 in order to observe a 'worst case' scenario.

The standard barley root elongation tests, based on International Organisation for Standardisation (ISO) 11269-1,1993, were undertaken to observe the short-term effects of various treatments of the Fuyang soil, with respect to alleviating phytotoxicity to barley, and with the aim to determine the most effective amendment(s) or their combination. The aim of the pot experiments was to study the long-term effects on the crops using the Fuyang soil combined with the most effective amendments determined following the root elongation tests. The objective of the field trial was to study the long-term effects on the energy crops at an actual site with metal contaminated soils and observe plant biomass and metal accumulation using selected amendments based on the laboratory experiments over one harvest period.

Lime was the most effective amendment trialled at decreasing available copper and zinc concentrations and increasing the soil pH, however it was found that if too much lime was added which increased the soil pH to above 7.8, this resulted in an increase in available copper concentrations and resulted with phytotoxic effects on the plants. Other effective amendments at practical application rates were bentonite and zeolite.

Overall it can be concluded that the sweet sorghum, sugar cane and vetiver grass all grew successfully during the field trial. These crops were generally tolerant to the site conditions at Fuyang and they achieved yields in line with industry standards. Both sweet sorghum and sugar cane achieved the highest yields in areas with lower available copper and zinc concentrations whereas vetiver grass only had a decrease in yield where higher available zinc concentrations were present. Whilst the results showed some evidence of metal accumulation within the leaves of the sweet sorghum and within the roots of the sugar cane, further studies are required to demonstrate whether the plants are 'cleaning up' the metals in soil.

Statement of Originality

I Sally Egan certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Acknowledgments

I would like to acknowledge and thank the many people who have provided invaluable guidance and support throughout my research and contributed to the production of this thesis.

- ◆ My University of Adelaide supervisors; Associate Professor Mark Jaksa and Associate Professor Trevor Daniell for providing ongoing support and encouragement throughout my research. I would also like to acknowledge Dr David Walker and Martin Lambert for also providing helpful advice along the way in order for me to complete this masters thesis.
- ◆ Professor Yongming Luo, my external supervisor, and Dr Jing Song at the Soil and Environment Bioremediation Research Centre (SEBC) at the Institute of Soil Science in Nanjing, China. All the staff and students at the SEBC including Mr Shitou Huang, Mr Yunyu Pan and Mr Hong Zen Zhang. The team at SEBC were not only a great team of people to work with, but they welcomed me to Nanjing and helped make my time there an enjoyable and truly unforgettable experience.
- ◆ The Australian Youth Ambassadors for Development (AYAD) programme, which gave me the opportunity to live, work and commence my masters research in Nanjing. It was a rewarding and challenging experience, which I will always remember fondly. I would like to acknowledge the AYAD in-country management team and my fellow AYADs who provided me with great support whilst living in China.
- ◆ My husband, Damien Egan, for providing me with constant support whilst I was based overseas in China and when I was back in Adelaide trying to finish my thesis whilst working full time. I would also like to thank and acknowledge my family (Phil, Jan and Jodie Roach) who have always provided me with encouragement and believed that I would complete my masters.
- ◆ Mr Len Turczynowicz for suggesting that I undertake my own research while I was in China and providing words of encouragement along the way.
- ◆ My former managers, Marc Andrews and Peter Berndt, at my current employer (Coffey Environments) for allowing me to take a leave of absence to be a part of the AYAD programme in China and commence this masters by research.