

Optimizing Mushroom Spawn Production in Uganda

Pradeep Malakar¹, Qi Tan², Mingjie Chen², John Buswell², Zengtao Xing³, Qui Sun⁴, Xiaoping Wei⁴, Charles Kwesiga⁵, Jane Nampala Mayambala⁵, Arthur Tugume⁶, Perpetua Ipulet⁶, Peace Byandusva⁷, James Akanyijuka⁷, Magda Verfaillie⁸

¹Institute Food Research, Norwich, UK; ²Shanghai Academy of Agricultural Sciences, China; ³Shanghai Municipal Agricultural Commission, China; ⁴Guizhou Academy of Agricultural Sciences, China; ⁵Uganda Industrial Research Institute, Kampala, Uganda; ⁶Makerere University, Kampala, Uganda; ⁷Mushroom Training and Resource Centre, Kabale, Uganda; ⁸Mycelia, Nevele, Belgium

Abstract:

Most farmers in Uganda own less than an acre of land, which is typically used to grow crops such as bananas, pineapples and cassava. Mushroom cultivation requires less space, takes place near the home and has the potential to improve the lives of thousands of small land holders, especially women. However, for various reasons, farmer groups in Uganda are presently unable to meet the demand for high quality, fresh and dried mushrooms. This project, initiated in March 2014 and funded through the Agri TT (Agricultural Technology Transfer) programme, is directed at addressing current deficiencies in, and impediments to, the development of the Ugandan mushroom industry. The project introduced several key innovations that have made China the world's pre-eminent mushroom producer. These include: the provision of uninterrupted supplies of robust, high quality, genetically-stable spawn (through the Mushroom Training and Resource Centre [MTRC] and registered spawn producers) capable of generating high yields of quality mushrooms and using a wide range of cheap, readily-available cultivation substrates under the diverse climatic conditions prevailing in different regions of Uganda. It also includes establishing a germplasm bank to protect and conserve indigenous mushroom resources and a comprehensive breeding programme for enhanced strain performance. The other issues are introduction of a Field Technical Service coupled to educational and training elements to ensure a sustained supply of 'home-grown' mushrooms and mushroom biologists, and engagement with the Ugandan government to establish a National Mushroom Policy and Strategy.

Background:

Present activities of mushroom farmers active in the region of Kabale, Southwest Uganda, are directed at *Pleurotus ostreatus* cultivation, but yields are often poor due to problems associated with mushroom spawn production and quality including:

- Contamination of spawn during the production process.
- Poor quality spawn produced by local spawn producers.
- Limited spawn production levels that cannot meet demand.
- High cost of spawn.
- Losses due to inadequate spawn storage and distribution capacity.
- Unreliable power supplies.



Mushroom Training and Resource Centre [MTRC], Kabale



Mushroom growers and researchers attending the 1st dissemination event at MTRC, Kabale, May, 2014



Training in spawn production at MTRC



Preparation of growth substrate



Pleurotus ostreatus cultivation at MTRC



Pleurotus ostreatus harvest

Methods and Materials:

In order to address the key problems facing Ugandan mushroom farmers, the following activities will be undertaken:

Selection of newer, robust, genetically stable strains, which possess organoleptic qualities acceptable to the targeted consumer, are suitable for cultivation on substrates that are locally available in plentiful supply, and for which the environmental conditions for growth and fruiting are readily achievable at low cost. In the short term, it is proposed that imported species of known provenance and cultivation characteristics (e.g. optimal environmental requirements, yields, biological efficiency values on different substrates) should be adopted although the availability of indigenous species should be explored in the medium term. Attention will also be given to providing facilities for storing 'mother' cultures of selected strains under conditions that maintain viability and genetic stability.

Development and optimization of systems for producing good quality, stable spawn. Following selection of suitable fruiting cultures, a range of spawn substrates will be evaluated since various associated features (e.g. composition, particle size, texture) influences the rate of mycelial growth within the spawn medium as well as during spawn running following inoculation. It may also influence the storage qualities of the spawn and help it to withstand degeneration associated with handling and environmental fluctuations. Provision of facilities for producing, storing and transporting a continuous supply of good quality and reliable spawn will also be addressed.

Development of differently formulated combinations and pre-treatments of readily available lignocellulosic materials to provide suitable cultivation substrates. These will be designed to promote growth of the mushroom mycelium to the practical exclusion of other microorganisms: i.e. be rich in essential nutrients in forms that are readily available to the mushroom, devoid of spawn growth inhibitors, of appropriate moisture content and pH value, and provide for good gaseous exchange between the substrate and the surrounding environment.

Optimisation and management of mushroom development conditions. Details of current practices relating to cultivation methods (e.g. substrate composition and preparation, spawn inoculum size, size of cultivation bags, temperature control during spawn running, management of mushroom development) adopted by individual farmers will be analyzed and appropriate improvement strategies introduced.

Introduction of a system of registered spawn producers. Poor spawn quality is often traceable to untrained and unqualified spawn producers using sub-standard materials and unsophisticated methodology. In order to eliminate inferior sources of supply, it is proposed to introduce a system of registered spawn producers. Higher costs that may ensue will be minimised by the introduction of credit/partial payment schemes which, in the latter case, will also act as an incentive for the spawn producers to maintain standards.

Infrastructure improvements at MTRC. These will involve upgrading laboratories and inoculation rooms, and the installation of a solar-power system to ensure more stable energy supplies.

Preparation of a catalogue of mushroom strains indigenous to Uganda. This will be comprehensive and include, for example, data relating to the location, altitude and nature (e.g. forest, grassland) of the collection site, prevailing climatic conditions, and mushroom distribution patterns. Canvassing of growers and the local population in general about sightings of mushroom fruit bodies growing in the wild will be employed in this context.

Collection and collation by MTRC of data relating to the impact of programme activities on grower profitability. MTRC will develop an accurate and representative system for the continuous collection and collation of data from farmers and in-house trials relating to improvements in, for example, spawn quality and stability, fruit body quality and yields, overall profitability emanating from the action strategies outlined above.

Introduction of a Field Technical Service (FTS). Coupled to research, educational and training elements involving MTRC, the Uganda Industrial Research Institute, Makerere University and Guizhou Academy of Agricultural Sciences, the FTS will serve as a conduit to facilitate feedback from the growers based on their practical experiences as well as technology transfer between farmers and researchers.

Results and Discussion:

Expected outcomes of the proposed action strategies will ensure the future sustainability of Uganda's mushroom industry by:

- Increasing the capacity of MTRC and other certified suppliers to produce high quality spawn at reasonable cost, thereby eliminating current shortages.
- Reducing losses incurred during the mushroom cultivation process, thereby raising the profitability of growers and MTRC.
- Aiding diversification into the production of other mushroom species which command higher market prices, and ensuring a sustained supply of 'home-grown' mushrooms.
- Improving the training capacity of MTRC.
- Raising the standard of MTRC and its products within the region, thereby enabling the Centre to lead the drive for new innovations in research and development.
- Facilitating engagement with the Ugandan Government aimed at establishing a National Mushroom Policy and Strategy.



Assessment of cooked sorghum



Drying system for oyster mushroom



Ugandan mushroom project meeting at UIRI, Kampala, May, 2014



Training session at UIRI



Training farmers at MTRC and in the communities

Acknowledgement:

This project is funded through the AgriTT (Agricultural Technology Transfer) programme.