Utilisation of wastewater for fuel and fodder production and environmental and social benefits in semi-arid peri-urban zones of sub-Saharan Africa

Results

Project Information

UBENEFIT

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Deliverables

Treatment of domestic wastewater using conventional stabilisation system

Until recently irrigated vegetables and other crop products during the dry season in many urban zones of Burkina Faso relied mostly on the use of non-treated domestic wastewater, (mainly because of the scarcity of non-polluted water sources), a practice which is known to be associated with health and environmental risks.

A pilot wastewater purification station has been designed to treat to World Health Organization (WHO) standards wastewater for use in irrigated fodder and fuelwood tree plantations. The monitoring of water quality showed that Low-cost stabilisation ponds system successfully improved the microbiological quality of the wastewater, thus preventing the environment from pollution.

On the one hand, counts of faecal coliforms were reduced to approximately 104/100 ml, and on the other hand, a range of other disease agents such as helminth egg, ascaridae and various harmful cysts were entirely eliminated since they were found only in the raw sewage.

These counts were found in agreement with the range of 103/100 ml for faecal coliforms and less than 1 worm L-1 of WHO guidelines for agricultural irrigation. In addition, though being diluted by rainfalls, the treated wastewater still contained high amounts of phosphorus (about 0.7 mg PO4 3- L-1) and nitrogen (5.3 mg N L-1) compared with the range of values commonly found in soils of the area suggesting that no fertilisation of tree plantations would be further needed.

Inoculation with Myccorhiza and rhizobium has a benefic effect on trees species fuelwood and fodder production

The double inoculation with mycorrhiza and rhizobium has great positive effect on the fuel wood and fodder production of trees species.

The inoculation with rhizobium and mycorrhiza has a positive effect on plants production. It is 67% greater than the control (29.150 t ha-1 against 17.450 t ha-1) for fuelwood production and 35% for fodder production (23.750 t ha-1 against 17.600 t ha-1).
Inoculation with Myccorhiza and rhizobium has a positive effect on plant water use.
In august when the weather is favourable, the sapflow amount which is less than 300g m-2 of leaf area h-1 with the double inoculation (R+M) is more than 500g m-2 of leaf area h-1 for the control.
Acacia mangium is the more adapted and the best performing species than the others Australian.
The screening experiment show that Acacia mangium seems well to be more adapted and is one of the best performing species than the others Australian Acacias in our irrigated condition in Siribala.

Acacia angustissima has a high water demands compare to the other species.
In humid period, with or without inoculation the sapflow amount is higher for this species than the other. It's more than the double of those of Gliricidia sepium and Khaya senegalensis. Consequently, Acacia angustissima appears as the less adapted specie in semi-arid zone of Siribala. However, in relatively humid areas this species could be advised because it biomass production is not negligible (17 tha-1 of fuelwood and 18 t ha-1 of fodder).

The soil water content is always smaller in the upper layers than in the deeper layers because of the plant's withdrawal.

Soil water content according to species (p= 0.484 in January and 0.261 in August) is the same but it varies significantly according to depth (p= 0.033. For all the species, with or without inoculation, soil water content is smaller from the soil surface to 30 cm depth. Then the profile became more humid in the deeper soil layers. The interview on each species shows that 90% of the women found that Leucaena leucocephala is a good fuelwood and evaluated the price of 85 kg at 500Fcfa (1 US dollar). Contrary only 40% of the women identified Acacia angustissima as a good fuelwood and evaluated the weight of 45 kg at 200 FCFA.

* According to fuelwood quality, women classify the species as follow:
Leucaena leucocephala,, Gliricidia sepium, Khaya senegalensis, Accacia angustissima.

* According to appetence, goats have greatly eaten Acacia angustissima, Leucaena leucocephala, Calliandra Calothyrsus, Pterocarpus lucens and Acacia Senegal (Acacia mangium and Gliricidia sepium being less eaten when fresh). All the 10 species have been greatly eaten by sheeps. Ox eat only 3 species: Leucaena leucocephala, Acacia angustissima and Acacia auriculiformis. Only Pterocarpus lucens has been eaten by donkeys.

Tools for quality control of microbial inoculants in tropical agriculture and agro-forestry

Potential applications
We adapted a classical method of molecular hybridization for microbial inoculant characterization and we developed a simplified procedure to isolate DNA from nodules of tropical legumes. It allows the development of simple tools to assess the quality of microbial inoculants applied in tropical agriculture and forestry.

End-users
Primary end-users will be:
-Laboratories selecting appropriate microbial strains, to follow their behaviour and efficiency in field experiments.
-Quality-control services, to assess the identity of the strains in the inoculants.
More largely, the farmers and foresters will at term benefit of high quality inoculants.

Main innovative features/benefits
The proposed tools are reproductive, safe and inexpensive, and adapted to basically equipped laboratories.

Analysis of the market or application sectors
Although beneficial effect of inoculation of trees and crops with selected micro-organisms is known

since many years and currently used in different parts of the world, inoculation technology is not developed in Africa. An increasing adoption by local users should hopefully be induced by actual promoting initiatives including networks such as ROPPA, who federates millions of farmers through twelve west African countries. Nitrogen fixing symbiotic bacteria inoculants can be either distributed by international manufacturers or produced by local units. Mycorhizal fungi are multiplied on plants and initiatives exist to test small production units supervised by farmer's organizations. In all cases, inoculants distributed to users must be controlled.

Potential barriers
The main barrier is the insufficiency of legal frameworks for the distribution and use of biofertilizers in Africa.

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