TECHNICAL NOTE - WORKSHOP

Objective

A workshop and visits from Embrapa's researchers team to define a strategy for Technical Project Cooperation (TCP) between Embrapa and Rural Development Administration (RDA).

Subjects

The proposed fields in this Technical Note agree with the areas included at Memorandum of Understanding (MoU) subscribed by RDA and Embrapa on November 19th, 2008 (SAIC Embrapa 10200.08/0263-3), that were: engineering/automation, botany, animal sciences, development of genetics resources, bio-energy, agri-ecology and environmental sciences
The prospection of the partnership opportunities, that are part of the Coordinator "Work Plan", was presented and approved for the SRI, was carried through techniques visits and analyses of the main results gotten for the diverse RDA's Institutes. The main subjects had been presented for the Units during the visits carried through in the period of August/September 2012. In this first phase, considering diverse parameters were defined as priorities the following subjects:

- Applied biotechnology for food and feed additives;
- The use of animal waste to produce bioenergy and by-products;
- Protected cultivation (greenhouse production) and processing of vegetables.

Potential Units of Embrapa

- Embrapa Swine and Poultry
- Embrapa Vegetables
- Embrapa Genetic Resource and Biotechnology

Potential Units of RDA

- National Institute of Animal Science (NIAS)
- National Institute of Horticultural & Herbal Science
- National Agrobiodiversity Center

Area 1 - Applied biotechnology for food and feed additives

Related to animal production, Embrapa Swine and Poultry have been dedicated to develop management, breeding, raw material analysis, nutritional recommendations, sanitary monitoring programs and vaccine development.

In the field animal feed additives, many performance and metabolism trials have been done along decades in order to understand and better recommend its usage. Recently, a new development stage have raised, the use of National Biotech Resources to develop new feed additives, such as pro and prebiotics, enzymes and other. Complementary to these, there is as well a project to implement a sophisticated lab dedicated to analyze and characterize the Brazilian feedstuffs used in animal nutrition in terms of anti-nutritional factors.
All those efforts so far have been driven throughout an Embrapa inter-center action. However, it has been discussed to evaluate the possibility of an international cooperation with a well developed institution in this field.
The Rural Development Administration (RDA) seems to meet required knowledge and constitutes a potential partner to integrate the Applied Biotechnology area for human and animal feed additives, health and welfare.

1.1. Development of enzymes for food and feed use generated from Brazilian biodiversity

The objective of this project is the bioprospection of Brazilian resources for new metabolites (enzymes) for food and feed application. This Project is relevant because Brazil is one of the main animal protein producer and investments in this area could work in favor of a less expensive production and/or more sustainable production systems associated to a healthier and tastier food.

1.2. Development of probiotics and prebiotics for human and animal health and welfare

Probiotics

The objective will be the evaluation of National microbes (bacteria, yeast and moulds) with potential as probiotics. Such kinds of additives have been used in favor of animal and human health improvement. Considering the enormous bioresources in Brazil, it is believed that many potential not yet discovered microbes could be identified and used for this proposal. Some Embrapa R&D Centers have been already working in this area, i.e., Embrapa Wine and Grapes, Embrapa Food Technology and others.

Prebiotics

The use of biotechnology for prebiotic development has become more common along the last years. Additives like gums, flavors, toxin binders, gut health enhancers and others have been developed. As mentioned in the previous item (probiotics), it is believed that Brazil has an enormous potential in terms of biodiversity unexplored so far for this proposal.

1.3. Development of inoculants for environmental protection and sustainability.

Inoculants for hydrolysis of agricultural residues and contaminants.

Considering a growing demand of food and feed, it is expected that a higher output of contaminants to the environment will happen. Based on this statement a need for efficient biodegration systems enriched with potential inoculants coming from national resources seems to be another important development area. Microbes that turn de degradation of animal manure, urban effluents, slaughter houses effluents and other processes residues faster can be of extreme benefit in the near future.

Research interest: Applied Biotechnology for animal production; Genomic Approaches, Findings and Analyzing Microorganism Metabolic Gene Clusters; Microorganism Genetic Manipulation for enzyme production; Solid State Fermentation: Fermenters design and process controls. Enzymes production technologies.

Focal Point: Dr. Everton Kabbe, Embrapa Swine and Poultry

Area 2 - The use of the waste from animal production to produce biofuels and By-Product

Brazil is the fourth larger swine producer and exporter of the world. This position was achieved with significant changes in the production systems over the last 30 years, from a small, subsistence model to larger confined animal feeding operations. However, confined swine production has been a major public concern in Brazil due to the large amount of waste generated in these operations and its potential impact on soil, air, and water quality, urging the necessity of proper manure treatment and disposal.

Composting of swine manure is an alternative that has been promoted in Brazil to manage swine manure. This practice allows water evaporation and transforms liquid manure into a solid material of high organic value as biofertilizer that is easy to handle and transport to nearby fertilizer demanding lands. The project is evaluating greenhouse emissions during composting and proposing innovative technologies to accelerate biological metabolism towards composting and emissions reduction.

The use of liquid manure as fertilizer is also being evaluated. Its benefits as a biofertilizer suggest that it is a promising compound compared to expensive mineral fertilizers. Besides testing biofertilizer concentrations in several crops the project is also evaluating new equipment's to better distribute and release the biofertilizer in soils in ways to optimize nitrogen fixation and minimize emissions to atmosphere.

Anaerobic digestion of manure produces biogas methane that can be utilized as a sole source of fuel or to generate electricity. The biodgestors technologies are being studied in ways to efficiently promote biogas volumes as well as its quality. There is an increasing interest to develop biogas energy centers in Brazil, particularly for electricity generation. Biogas filtration methods are also being investigated.

Swine waste effluent is usually partially treated using biodgestors which is quite efficient to remove the organic carbon but nutrients such as nitrogen and phosphorus. These nutrients can ultimately cause eutrophication of water bodies. Lagoons are usually installed downstream of biodgestors to minimize nutrient load. Nonetheless, land availability may not always be suitable. The use of SISTRATES (swine wastewater effluent treatment system) can be quite effective to remove such nutrients producing high quality water that can be reused. During the treatment process phosphorus can be removed and utilized as a valuable source of fertilizer.

The use of microalgae as a feedstock to produce biofuels, food and pharmaceutics is regaining credibility and attention worldwide. Microalgae can growth using nutrients from swine waste effluent thus treating the effluent while simultaneously generating valuable biomass. Engineered photobioreactors or open lagoons are being studied as a means to treat effluent from agribusiness and evaluate the potential of the biomass as a source of bioenergy and animal nutrition.

2.1. Composting

Automated composting systems have been developed at EMBRAPA for swine manure treatment with significant success. The main challenges includes: minimize nitrogen losses during composting process leading to a nutrient-rich organic fertilizer; improvement of nutrient use efficiency by plants amended with the compost; and evaluation of the environmental benefits associated to composting (reduction of greenhouse gases emissions, enhancement of soil organic matter content and soil quality, nutrient reclying between animal farming and agricultural systems based on the replacement of finite mineral fertilizers by organic or inorganic-mineral fertilizers).

2.2. Swine wastewater effluent treatment

Several biological and chemical-physical treatment combined processes have been considered for carbon, nitrogen and phosphorus removal. Some example includes the use of the patent pending SISTRATES technology by EMBRAPA.

2.3. Microalgae

Phycoremediation and engineered photobioreactors is currently being exploited as a polishing wastewater treatment technology to simultaneously produce valuable biomass that can be converted to biofuels or other byproducts.

2.4. Biogas

With the increasing worldwide interest for renewable and sustainable energy sources, EMBRAPA has committed over 30 years of its environmental research on biogas production.

2.5. Bioprospection

Isolation of microorganisms from swine and/or poultry wastewaters and that can have several applications in biotechnology, including biofuels, production of interesting building blocks compounds and/or animal nutrition.

Research interest: New Technologies for wastes management; Innovative and automated composting Technologies; Biofertilizer life-cycle analysis and assessment of their agronomical value.

Focal Point: Dr. Rodrigo Nicoloso, Embrapa Swine and Poultry

Research interest: Photobioreactors; Light Emitting diode (LED) technologies for biotechnology use; Phycoremediation; GMO´s; Microorganism´s prospection focusing on advanced biofuels processing; Microorganisms genome sequencing.

Focal Point: Dr. Marcio LB da Silva, Embrapa Swine and Poultry

TENTATIVE SCHEDULE PROGRAM

Theme	Area	Topics	Institution/Speaker
I	General	Brazilian Swine and Poultry Production Chain	Embrapa Swine and Poultry – Dr Everton Kabbe
		Korean Swine and Poultry Production Chain	National Institute of Animal Science – to define
II	Brazilian Swine and Poultry Production Chain and Opportunities for Biotechnological Tools.	Applied Biotechnology for animal production; Genomic Approaches, Findings and Analyzing Microorganism Metabolic Gene Clusters; Microorganism Genetic Manipulation for enzyme production; Solid State Fermentation: Fermenters design and process controls. Enzyme production technologies.	Embrapa Swine and Poultry – Dr Everton Kabbe National Institute of Animal Science – to define
III	Mitigation of greenhouse emissions from swine wastes as biofertilizer.	Research interest: New Technologies for wastes management; Innovative and automated composting Technologies; Biofertilizer life-cycle analysis and assessment of their agronomical value.	Embrapa Swine and Poultry – Dr Rodrigo Nicoloso National Institute of Animal Science – to define
IV	Bioremediation of swine wastes with simultaneous generation of valuable byproducts.	Research interest: Photobioreactors; Light Emitting diode (LED) technologies for biotechnology use; Phycoremediation; GMO´s; Microorganism´s prospection focusing on advanced biofuels processing; Microorganisms genome sequencing.	Embrapa Swine and Poultry – Dr Marcio Buzi National Institute of Animal Science – to define

Area 3 - Protected cultivation (greenhouse production) of vegetables

The protected cultivation (greenhouse production) of vegetables in Brazil has grown in size and economic importance. Several research efforts have been made in order to address the different agronomic and environmental aspects by national research institutions, albeit uncoordinated. Due to the large Brazilian territory, such a system of cultivation is practiced for different reasons in different regions of Brazil, although one main reason is the protection of crops from the weather, which is of great importance especially for vegetables, in which product quality may be as important as the physical production per se. The rising cost and shortage of manpower for agriculture are also beginning to lead to the adoption of protected agriculture in certain regions of Brazil.

3.1. Control of the internal environment

Control of the internal environment (temperature, light, humidity, partial pressure of carbon dioxide) in protected cultivation is still only partially practiced in Brazil, among other reasons for the high final cost of production. Even if there were a market for crops produced under such conditions in Brazil, there is a large gap in knowledge to allow the control of such environmental variables under tropical conditions. The degree of adoption of technologies is extremely heterogeneous among Brazilian farmers. Although both hydroponic and substrate cultivation are already being adopted by increasing numbers of farmers, most of the protected cultivation in Brazil is done directly on the soil.

3.2. Biological Control

In soil cultivation under protected agriculture, there is a resistance (and sometimes lack of options) for farmers to establish systems of crop rotation, thus enhancing the risk of accumulating pests and soil diseases, especially by the practice of spatial and temporal monoculture but also by the environmental conditions created within the greenhouses. Although there have been attempts at introducing the technology of biological control in Brazilian greenhouses, a better understanding of the behavior of parasites and parasitoids under such conditions is still necessary for the thorough use of the technique.

3.3. Mineral nutrition of vegetables in greenhouses

There are certain specificities regarding the management of mineral nutrition of vegetables in greenhouses that should be taken into consideration under the risk of making cultivation impossible once problems arise. A major factor influencing it is that in a protected environment there is little or no input of rainwater. The water entering the system comes almost entirely from irrigation which is often localized, such as drip irrigation. As vegetables mineral nutrient requirements are usually high, there is a tendency to accumulate salts in the surface, increasing the electrical conductivity of the soil solution, which negatively affects both the production and the environment.

3.4. Technology Innovation for small farms

Due to accelerated urbanization, better salaries and government aid programs, manpower availability to agriculture is becoming gradually scarcer and more expensive. Although there are attempts at turning agricultural practices more mechanized and automated under greenhouse production, machinery is still

more expensive and less available than human labor. National industries and solutions are rare and even research on such topics is still at its beginning.
South Korea has produced a considerable portion of their crops under protected and controlled conditions, and not only vegetables and ornamentals, as in Brazil. The scarcity of natural resources and labor, as well as the quality requirements of the Korean consumers has led research institutions and producers alike to invest heavily in innovative technology solutions for protected agriculture, particularly with regard to automation, the rational management of water and nutrients and the biological control of pests and diseases. Although the research team involved with greenhouse horticulture at Embrapa Vegetables has been working in these areas, the technical and scientific exchange with Korean researchers and even greenhouse farmers could represent a valuable "shortcut" on the acquisition of knowledge capable of guiding research directions in protected agriculture in Embrapa and make the system more competitive in the Brazil.

3.5. Postharvest handling of vegetables

The vegetables' postharvest losses are directly related to handling, transport and storage inadequate product from harvest to sale's point. It's can be due several factors such as mechanical damage, use of packaging improper, marketing of bulk, non-use of the cold chain, inadequate transportation, no standardized classification, road condition, excessive handling by consumers, inadequate exposure of the products, among others.
The Republic of Korea has an advanced manager system after-harvest of horticulture products implemented, with the chain of the cold established for the majority of the products. From the fields of production to the commercialization there are height technologies being used.
Training to aggregate information and knowledge in the vegetable postharvest area which could be adapted to the Brazilian reality, may contribute to the reduction of postharvest losses in Brazil. It is also expected as larger training products narrowing between Brazil and Korea on this theme and the definition of possible joint activities in research, development and innovation.

Research interest: Greenhouse horticulture, plant mineral nutrition, hydroponics, aeroponics, machines for small farmers

Focal Point: Dr. Ítalo M. R. Guedes, Embrapa Vegetables

Research interest: Postharvest handling of vegetables

Focal Point: Dr. Leonora M. Matos, Embrapa Vegetables

TENTATIVE SCHEDULE SUBJECTS

Theme	Area	Topics	Institution/Speaker
I	General	Impact of Green and White Revolution on Korean Agriculture development	National Institute of Horticultural & Herbal Science/To define
		Current researches status and production of vegetables in Brazil	Embrapa Vegetables/Dr. Ítalo M. R. Guedes
II	Current researches and technologies	Current researches and technologies for Environment control and mineral nutrition	National Institute of Horticultural & Herbal Science/To define
	Current researches and technologies	Current researches and technologies for Biological control of pests and diseases	National Institute of Horticultural & Herbal Science/To define
	Current researches and technologies	Current researches status and production of vegetables using protect production in Brazil	Embrapa Vegetables/Dr. Ítalo M. R. Guedes
III	Food Processing and Preservation	Traceability of vegetables and fruits, using technology of net without wire	National Institute of Horticultural & Herbal Science/To define
		Development of improved industrial process for vegetables in Korea	National Institute of Horticultural & Herbal Science/To define
		Packaging development targeting the visual impact, conservation and quality of the product in the supermarket	National Institute of Horticultural & Herbal Science/To define
		Current researches and status of vegetables processing and conservation in Brazil	Embrapa Vegetables/ Dra. Leonora M. Matos
IV	Agricultural Engineering	Development of machines for small farmers in Korea	NASS/Department of Agricultural Engineering

Gilberto Silber Schmidt
Rural Development Administration
Embrapa/Coordinator Labex Korea