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USING BIO-STIMULANTS TO OPTIMIZE MINERAL FERTILIZER EFFICIENCY: A CONCRETE EXPERIENCE ON FIELD CROPS IN VIETNAM

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Using bio-stimulants to optimize mineral
fertilizer efficiency :
A concrete experience on field crops in Vietnam

Lecture by Mr Eric Marnat, *GM*



BACONCO CROP CARE
Ho Chi Minh City
Vietnam

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What is it about ?

- ✘ A new biotechnology allowing to ***increase significantly the efficiency of mineral fertilizers***
- ✘ What are the scientific foundations of this technology
- ✘ How this technology was developed, tested, and used on an industrial scale, and what are the results

Some clarification



EVL inc.

- ✘ is a Canadian biotech company and is the *patent owner* of the technology which is mentioned in this presentation
- ✘ is developing the technology in different countries, and has concluded an agreement with BACONCO in Vietnam in 2005.



BACONCO CROPCARE Ltd

- ✘ is a Vietnamese company, subsidiary of French Group SSI, producing NPK fertilizers (about 200 000T per year), and distributing products for agriculture
- ✘ has been the first company to *use EVL technology on an industrial scale.*

What do we mean by “bio-stimulant” ?

Bio-stimulants are *organic substances* which have a *physiological action* on the crops :

- ✘ It can be organic substances like seaweed extracts, vegetal hormones etc
- ✘ It can be LIVING bio-organisms which will interact with the crops

Only this kind of bio-stimulant will be discussed today

Why using bio-stimulants ?

Agronomists have already established the importance of the microbial flora in the soil :

- ✗ Some microbial strains are active in the process of *mineralization of the nutrients* (for example, nitrification process) ;
- ✗ Some are helping *absorption of the mineral nutrients* by the roots ;
- ✗ Some have a direct synergic effect with the *root development* of the plant ;
- ✗ Some are *inhibiting the development of undesirable flora* (probiotic effect) ;
- ✗ Some other effects are discovered every day...

Fact : soil microbial flora is having a direct impact on the fertilization efficiency.

Concern : soil microbial activity has been very often seriously affected by intensive agricultural practices.

An interesting parallel

ANIMAL NUTRITION The *probiotics*

- inhibits development of pathogens
- Increases the assimilation ratio of food (digestibility)

CROP NUTRITION The *bio-stimulants*

- promotes development of useful flora
- Increases the nutrients uptake (efficiency)

Some microbial strains are very similar for both applications

Bacillus subtilis, lactobacillus acidophilus...

Developping quickly

Not yet... why ?

What are the challenges ?

- ✗ **STRAINS SELECTION** : hundreds of strains of each species are existing with a big variation in their activity ;
- ✗ **STRAINS STABILITY** : some strains can mute easily, or their activity can change depending of the environment ;
- ✗ **PRODUCT INNOCUITY** : some strains can be contaminated with pathogens, or can mute into pathogen form. Health authorities of each country very often requires preliminary studies of the product ;
- ✗ **PRODUCT CONSERVATION** : we are dealing with living material. How to keep it active until its application on the field?
- ✗ **PRODUCT APPLICATION** : How to make it easy to use for the farmer ? Without asking him additional work or complicated recommendations ?

What is in the market today ?

- ✗ Some strains in vegetative form. Only possible with an organic substrate. The products concerned are organic (mainly composted).

Ex : actinomyces, saccharomyces cerevisiae, nitrification bacterias...

PROBLEM : convince farmers to use sufficient amounts of expensive manure



- ✗ Some strains in powder form (sporulation + dehydration).

PROBLEM : to be used with foliar application only, and the activity of the strains under this form is very uncertain

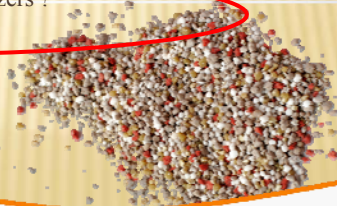


- ✗ Strains associated with mineral fertilizers ?

THERE WE GO ...

EVL biotechnology

Giving life to mineral fertilizers



EVL biotechnology : the principles 1/4

- ✘ The production of a **microbial solution** made of **five complementary strains** selected for their capacity to generate specific synergic and symbiotic effects once introduced in the soil
- ✘ The **impregnation** of the microbial solution **onto mineral fertilizer**



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EVL biotechnology : the principles 2/4

- ✘ The biotechnology relies on the production of a powerful and unique **microbial solution** that can be **impregnated on mineral fertilizer**
- ✘ Hosting onto granular fertilizer, the micro-organisms, once in the soil, interact with mineral ionization, solubilization and the catabolic process
- ✘ Their action substantially **promotes the nutrients transfer from the mineral fertilizer and the soil to the plant**, increasing the uptake that leads to better yields and crop quality
- ✘ The micro-organisms are fermented in a such a way to get a perfect equilibrium **and the ability to stay latent onto the fertilizer granules***, and ready to be active once in the soil. The cells are keeping their full capacity to re-activate up to 12 months after impregnation.

* International Patent Pending



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EVL biotechnology : the principles

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- × The microbial solution is made of the following element* :
 - × *lactobacillus acidophilus*
 - × *bacillus subtilis*
 - × *bacillus licheniformis*
 - × *pseudomonas putida*
 - × *saccharomyces cerevisiae*

* International Patent Pending



EVL biotechnology : the principles

4/4

- × Each strain has been carefully selected for its own capacity to generate ***specific synergic and symbiotic effects*** once introduced in the soil
- × The EVL microbial strains selection helps with the ***production of endo-enzymes*** playing a fundamental role in the transformation and assimilation process of organic and mineral molecules by the plant
- × The EVL microbial strains selection plays a role in the ***transfer mechanism of minerals*** that could even start before the colloidal stage of the assimilation process
- × The EVL microbial strains selection also works in such a way to ***reproduce probiotics inhibiting the undesirable flora***, as it is often the case in food processing, where a strain only favours proper action from the desirable flora
- × As a result, the ***combined synergic effect*** of the strains on the plant growth mechanisms is greater than the sum of their individual effects

What are the challenges => the answers

- ✦ **STRAINS SELECTION** : hundreds of strains of each species are existing, sometimes with a big variation in efficiency ;
- **Use of selected strains, with a specific and recorded genetic card**
- ✦ **STRAINS STABILITY** : some strains can mute easily, or their activity can change depending of the environment ;
- **Regular renewal of strains + strict control of multiplication**
- ✦ **PRODUCT INNOCUITY** : some strains can be contaminated with pathogens, or can mute into pathogen form. Health authorities of each country very often requires preliminary studies of the product ;
- **Official registration of the product**
- ✦ **PRODUCT CONSERVATION** : we are dealing with living material. How to keep it active until its application on the field?
- **Appropriate preparation + fermentation, use of a new patented process**
- ✦ **PRODUCT APPLICATION** : How to make it easy to use for the farmer ? Without asking him additional work or complicated recommendations ?
- **Impregnate on mineral fertilizers**



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History

- ✦ **1998-2003 Conceptualization and Testing**
 - ✦ Canada – China (*laboratory and controlled-field trials*)
 - ✦ Hay – Poinsettia – Potatoes – Maize – Blueberries – Christmas Trees – Cotton – Cucumbers
- ✦ **2003-2006 Development and Improvement**
 - ✦ Canada – New Zealand – Vietnam (*laboratory, controlled and private-field trials*) (*small production of microbial solution*)
 - ✦ Christmas Trees – Maize – Potatoes – Fodder Beets – Hay – Spring Rice – Summer Rice – Cabbages – Cauliflowers – Watermelons – Onions – Arabica Coffee – Robusta Coffee – Tea
 - ✦ Vietnam : registration process, obtained in 2005
- ✦ **2006-2008 Industrial stage**
 - ✦ Vietnam (*automated production and impregnation of the microbial solution on the mineral fertilizer plant premises – many trials in real conditions with private producers*)
 - ✦ Rice – Rubber Trees



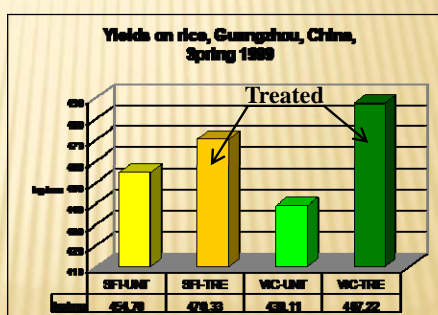
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Some testing results

1/2

- ✘ Tests realized in China – Soil and Fertilizer Institute Guangzhou 1999/2000
 - ✘ Cotton (no specific measurement)
 - ✘ Rice (3,7 to 7,4 %)
 - ✘ Cabbages (14 to 30%)
 - ✘ Cucumbers (2,9 to 16%)
- (% increase in yield between non treated and treated fertilizers With same nutrient amounts)



Some testing results

2/2

- ✘ Tests and demonstrations conducted by the National Soil and Fertilizer Institute of Vietnam (NSFI) – 2001-2003

Comparative Results Research Station / Farmer's Field

Crop	Research station		Farmer's field	Average
	Without manure	With manure		
Rice	9,80	8,60	10,50	10,15
Potato	11,00	8,00	14,40	12,70
Cauliflower	27,10	19,30	22,60	24,85
Onion	n.a	n.a	26,00	n.a
Arabica	11,26	n.a	29,40	20,33
Robusta	10,27	n.a	5,24	7,76
Tea	13,86	n.a	14,10	13,98

% increase in yield between non treated and treated fertilization with same nutrient amounts
In research station : comparison also done when using organic manure

Industrial stage : 1) bio-solution preparation

- ✘ Constraint : the bio-solution *must be produced in situ*, because it is not stable and must be *impregnated immediately* on the fertilizers ;
- ✘ Baconco invested in 2007 into an industrial tool, automated and computer-controlled, to *produce under licence of the patent owner*.



Industrial stage : 2) fertilizer impregnation

- ✘ Each batch of bio-solution is sprayed on the mineral fertilizers (one batch 500 L allows to impregnate 1000 MT ferts)



Commercial results

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- × Baconco has marketed *a range of fertilizer formulas* impregnated with the bio-solution. The name of this family is AVS (“ao vi sinh”, in Vietnamese)

- × Since its introduction, this family is knowing a growing success in the market :

2005	1 740 MT, 2 formulas, rice
2006	6 240 MT, 5 formulas, rice+maize
2007	9 335 MT, 6 formulas, rice+maize+rubber
2008	9 000 MT (to compare with our total volume down 30%)

our target is 50 000T (25% of our sales) within 3 years, with new formulas also on coffee and fruit trees

Commercial results

2/3

- × Demonstrations are regularly driven on *real farming conditions* to follow and promote the efficiency of the technology

- × On rice and maize, 30 producers involved in different provinces of Mekong delta, within a 3 year period :

(comparison treated/not treated with same amounts of fertilizing nutrients)

✦ **Rice** : From 7,5% to 18,8% increase in yield

(Average **14,1%** - Standard Deviation 2,67)

✦ **Maize** : From 7,56% to 9,32% increase in yield

(Average **8,45%** - Standard Deviation 0,74)

Commercial results

3/3

Farmers most frequent *visual reporting* about rice treated with AVS :



- 1) More developed roots
- 2) Bigger stem
- 3) Less sensitivity to insect and fungi disease

Economical results

Approach for the rice farmer of Mekong delta :

Average yield : 6T paddy/ha
 Paddy price : 230 usd/T (average 2008, farmer level)
 Fertilizers /ha : 400 kg (100N - 60 P2O5 - 50 K2O)

Benefit calculation :

Extra yield : 10% x 6T = 600kg
 equivalent to : 138 usd/ha
 equivalent to : 345 usd/T fertilizer

Cost of the technology : ≤ 50 usd/T (including patent royalties)

Extra cost of use : 0 : no additional application / workforce required
 (easier to promote to the farmers)



The appropriate market position has to be found to stimulate farmer's interest (by our experience should be more than 5% benefit), and to share the margin between the fertilizer supplier and the distribution network.

Synthesis

ADVANTAGES

- Impressive and regular result/cost ratio ;
- Reasonable investment cost ;
- Applicable with a very wide spectrum of crops ;
- Easy to use for the farmer

LIMITATIONS

- Does not work well in very acid soils ($\text{pH} < 5$) ;
- Does not work well with inappropriate fertilizer plan ;
- Registration required ;
- In situ production tool required for industrial quantities

CONCLUSION

- ✘ A new technology giving results... not only at the research station and applicable to a wide range of field crops
- ✘ Breaking the usual frontiers (mineral/organic, chemistry/biology,...) in our industry
- ✘ Opens a new way to increase the technical and economic efficiency of fertilization
- ✘ Is a part of the response to the growing concern about soil degradation and rising fertilization cost

Thank you for your attention !

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