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FIELD TRIP

Crop Science

Warsaw University of Life Sciences – SGGW

FNEA
FOUNDATION SCIENCE AND EDUCATION FOR AGRI FOOD SECTOR

International Farm Management Association
ifma

WNE
Faculty of Economic Sciences
– WULS-SGGW –

9:00 – 11:00 National Research Institute – Plant Breeding and Acclimatization Institute

Company: National Research Institute

About us

IHAR-PIB is the largest research center in the agriculture area in Poland. Institute covers fields of production technology of arable crops, agricultural biotechnology, biodiversity protection and conservation, monitoring of pathogens and also makes contribution to increase food security, protect natural environment and maintain national breeding of agricultural plants.

Our history

The Institute was established in 1951 with the headquarters at Radzików (near Warsaw). IHAR-PIB subordinates to the Ministry of Agriculture and Rural Development. Over years Institute underwent a num-ber o structural changes. At present IHAR-PIB conducts its research and breeding activities in 6 research branch divisions in Bonin, Bydgoszcz, Jadwisin, Kraków, Młochów and Poznań; 6 experimental stations and 5 affiliated Plant Breeding Companies of IHAR-PIB Group: Plant Breeding Bartążek Co. Ltd., Plant Breeding Smolice Co. Ltd., Plant Breeding Strzelce Co. Ltd., Pota-to Breeding Zamarte Co. Ltd., Agro-Inserwis Co. Ltd.

Main activities

The main subject of the Institute activity is to conduct research and development work in the field of agronomy, biotechnology in agriculture and other fields forming the scientific basis of breeding, seed production, agricultural production, storage and processing of agricultural and

Scientific cooperation To preserve highest standards of research, IHAR-PIB researchers participate in numerous international consortia and research programmes in Poland and aboard inter alia: INTERREG IV, EEA Grants (EOG), COST Actions, HEALTHGRAIN, BIOEXPLOIT, AGRI GEN RES, ENDURE, European Research Group, LIDER and many bilateral cooperation agreements with EU and other countries worldwide.

12:00 – 17:00 Research Institute of Vegetable Crops in Skierniewice

Company: Research Institute of Horticulture in Skierniewice

The Horticultural Research Institute in Skierniewice, Poland is a government R&D organization supervised by the Ministry of Agriculture and Rural Development. It was established on January 1st, 2011, by merging two research units with long traditions and great achievements in horticultural science: The Research Institute of Pomology and Floriculture (established in 1951) and The Institute of Vegetable Crops (established in 1964). The new Institute is a legal and organizational successor of its predecessors and inherited their staff and property as well as rights and obligations.

At present, the Horticultural Research Institute employs 568 people, of which 45 are professors, 85 doctors and 62 research assistants. Its research programmes cover all areas related to fruit, vegetable, ornamental plants and apiculture, from basic studies on physiology, biochemistry and molecular biology, through biotechnology, creative breeding, protection of genetic resources, agronomy, plant pathology, fruit and vegetable storage and processing, food safety, horticultural engineering, economics and marketing. Since all of the fruit and many vegetable plants are entomophilous and require bees for pollination, apiculture was also included in the Institute's programme. The Institute also takes part in several governmental research programmes on food safety, integrated and organic fruit and vegetable production, protection of genetic resources and in campaigns aimed at changing the nutritional habits of Polish consumers in favour of increased consumption of fruit and vegetables. Due to the active extension and implementation programmes and close cooperation with major stakeholders, the Institute has contributed to a large extent to the development of horticultural production in Poland.

Besides research, the Institute is also involved in commercial activities, especially in food analysis. Several of the Institute's laboratories have ISO/IEC 17025 and/or GLP certificates and perform analyses (pesticide residues, heavy metals, nitrites and nitrates and mycotoxins) for food producers and wholesalers. It is estimated that the Institute's laboratories have a 50% share of the commercial food analysis market in Poland.

The Institute actively participates in building the European Research Area. Cooperative links have been established with most of the horticultural research centres and clusters in Europe and several joint research projects, co-financed by the European Commission and other international organisations, have been initiated. At present, the Institute is involved in four projects within 7th Framework Programme and in several others within the Central European, LIFE and COST programmes as well as in bilateral projects financed by respective governments within ongoing agreements on cooperation in science and technology. In addition, the Institute is an active member of the European Fruit Research Institutes Network (EUFRIN). In Poland, the Institute is a coordinator of the Centre of Advanced Technologies "AgroTech", which is a cluster of three universities, two R&D Institutes and four commercial enterprises aiming at developing and implementing innovative technologies in the Polish agri-food industry and of a network, "Agroengineering for the sustainable development of the agri-food industry and rural areas". It is also a founder member of the Polish Food Technology Platform. In September 2011 the Institute organized the conference "Food and nutrition in 21st century", which was an official event under the framework of the Polish Presidency of the European Union.

The Institute is also an important teaching and training centre. It is authorized to conduct Ph.D. and postgraduate studies, summer schools and courses. Annually, on average five students receive Ph.D. diplomas, two D.Sc. diplomas (habilitations), and more than 700 students complete postgraduate studies and professional courses.

17:00 – 18:30 Jan Marczakiewicz – Chylice

Warsaw University of Life Sciences Agricultural Experimental Station (RZD SGGW)[1] in Chylice

Jan Marczakiewicz, M.Eng.,[2] farm tenant

The farm has an interesting history. It was founded in 1913 (during the Third Partition of Poland, in a territory taken over by the Russian Tsar) as a donation from Count Sobański (owner of the Guzowski Estate in Żyrardów County) for agricultural and industrial courses, and since 1921 it is the property of the Warsaw University of Life Sciences.

My story on the farm as a tenant and manager of the facility began in 2001. In most fields, the soil was of low quality and the meadows were treated as far back as 1913. We were getting cereals yields of on average 7-18 dt/ha, potato yields of 70-140 dt/ha, and corn of 30-50 dt/ha. Even though I was applying large amounts of chemical fertilizers and using intensive plant protection—in accordance with my professional knowledge—the soil was not as fertile as expected. I was looking for solutions. In trade publications I found information about beneficial microorganisms and decided to try them, even though it was against current agricultural practice.

Current crop structure

Total area of the farm: 560 ha, including 480 ha under crop cultivation.
The cultivation of potatoes for chips: 200 ha, seed corn: 280 ha.
Soil with a predominance of the 5^{th} and 6^{th} classes of soil classification, being of the lowest quality in Poland.

Theoretical requirements for the cultivation of potatoes and my practical experience

Professional cultivation of potatoes is difficult and expensive. According to the current state of knowledge and the recommendations of the advisory companies, the crop requires high fertilization (tab. 1) and application of intensive chemical crop protection.

Table 1. Recommended fertilization doses in kg/ha

		Variety			
		L. Rosetta	Saturna	Hermes	VR808
Nitrogen	N	240-300	180-200	80-100 (+60)	220-230
Phosforus	P_20_5	150-180	150-180	150-180	80-120
Potassium	K_20	280-350	200-250	150-180	200-280

Source: recommendation of the potatoes varieties owners.

[1] Warsaw University of Life Sciences—Szkoła Główna Gospodarstwa Wiejskiego (SGGW)
[2] Graduate of the Warsaw University of Life Sciences. Master's degree thesis under supervision of Prof. Ryszard Manteuffel.

What I do, or briefly about the biologization by probiotechnology which I have been using for 13 years

I regularly have the nutrient levels in the soils tested by giving soil samples from the various fields for chemical analysis (company Kam-Rol Kraków).

Field choice and treatments. Depending on the status of the soil nutrients, pH and humus content, I make a decision on the amount of fertilizers and plant protection products. Where there is less than 1% of humus content I use not only limited amounts of artificial fertilizers, as well as organic fertilization, but also **up to 500 l** of the special consortia **of beneficial microorganisms** found on the Polish market under the brand name **ProBio Emy**. On soils with humus content up to 5% I use only **20 l/ha** of **ProBio Emy** without phosphorus and potassium fertilizing.

Planting potatoes. Chemical treatment is replaced by Em Farma Plus with humic acids. Dosage at the time of planting: 30 l/ha, during the growing season: 50 l/ha.

Protection against disease pathogens. I start plant protection with safeguarding the fertile power of the soil. The application of ProBio Emy probiotic products accelerates humification and eliminates sources of the development of diseases and pests. I adapt doses of ProBio Emy products to the degree of soil degradation which is measured by the level of its humus content. During the growing season in preventive plant protection I replace fungicides by EmFarma Plus which I use every 3-14 days at a dose of 10 l/ha (for a total of up to 60 l/ha). In the case of fungal diseases (potato blight, alternariose – *Alternaria solani*, etc.) I use an appropriate fungicide.

Protection against soil pests and Colorado potato beetle. After application of EmFarma Plus, pathogens, pests, their spores, larvae, eggs, pupae do not develop into the adult form, and the eggs of the Colorado beetle are mummified while increasing the dominance of natural agents such as earthworms, ladybird and birds.

Protection of potato plantations against weeds. Probiotics stimulate the growth of crops as well as weeds. I eliminate the early germination of weeds before planting crops using cultivation machinery such as harrows. With a higher humus content in the soil, I use doses of herbicides at the lower recommended limits before potato germination in order to avoid plant stress. Depending on soil fertility, I apply EmFarma Plus before ridge formation at a dose of **30 l/ha—**the more the soil is degraded, the higher the dose.

Preparing the field to harvest potatoes. It is very important to prevent infection of the tubers before harvest and to prevent pesticide contamination of their residues, which disqualifies the potatoes as raw material for processing and for direct consumption. My experience indicates that gradually and where humus content is already optimal (> 3%) you can dramatically reduce the application of agro-chemicals.

Treatments for increasing the humus content. I sow green manures (mainly rye and mustard) which have phytosanitary characteristics. They are ploughed back in the spring, providing organic matter for humus formation. In addition, I use fermented peel and potato waste (technical literature suggests that they carry sources of diseases and pests) resulting from the production of chips. They are distributed by spreaders and mixed in with the soil. Since 2011, half of the surface of the cultivated corn is contracted for biogas. The post-fermented biomass from gas production goes back to the fields and is a component for humus formation, consequently improving the quality and fertile power of the soil. Both Polish and German analyses of such biomass show its very high fertilization value, which means that it can successfully replace the application of manure.

Effects of applying compositions of beneficial microorganisms in the Agricultural Experiment Station in Chylice.

Summarized data from 2006 and 2011 shows a clear increase of yields and decrease in fertilizer use.

	2006	2011	Yield increase in %
	Yields in dt/ha		
Potaoes	176	245	**39,2**
Seed maize	5,6	8,6	**53,6**
	Fertilization doses in kg/ha		Fertilization decrease in %
Nitrogen N	138	115	**-16,7**
Phoshorus P_2O_5	100	70	**-30,0**
Potassium K_2O	270	180	**-33,3**

Biologization allows me to cut two- to threefold of the doses of fertilizer recommended by consultancy companies.

In some years, potato yields are higher and can go up 300 dt/ha, which means that they are more than three times higher than the yield which I had obtained in intensive chemical cultivation without biologization.

Soil biologization increases, rather than reduces, nutrient's availability.

Year	Content of nutrient availability in mg/100 soil (average values)			
	ph in KCl	Phoshorus - P_2O_5	Potassium - K_2O	Magnessium -Mg
2011 (99 analysis)	6,10	**15,9**	**13,2**	5,3
2006 (95 analysis)	6,17	11,7	7,5	5,4
Increase/decrease of availability in %	98,8	**136,5**	**177,0**	98,7

The benefits of chemical plant protection reduction for homeostasis of the fertile power of soil.

Treatment	Benefit in PLN/ha	Total benefit in PLN
EmFarma Plus seasoning	120	24 000
Chemical tratments decrease (less 3 treatments)	300	60 000

These benefits are due to the replacement of the chemical seed treatment of potatoes with a treatment of EmFarma Plus (24 000 PLN) and reducing the amount of chemical spraying (60 000 PLN). In some years, they may be even higher. For example, in early potato cultivation on two plantations only the ProBio Emy probiotic products were used against fungal diseases. In this case my **profit per hectare increased depending on the plantation by about 1 000—1 800 PLN** (savings in applied agrochemicals and increased commercial yield with good quality parameters minus the cost of biologization)**.**

Consistent biologization of the soil and crops in my case has had the following effects:

An increase in the content of organic matter on the area of 440 ha with a level of 0,7-1,1% in 2001 to 1.8-2.7% in 2009 (depending on the field). In addition to the use of beneficial microorganisms, this effect is an effect of the cultivation of winter green manures (rye and mustard) and the use of fermented potato wastes (fermentation process eliminates the risk of developing diseases and pests). Both green manures and residues of corn and potato waste fermented with EmFarma Plus are the main source of the increased humus in the soil.

High quality yields. Potatoes delivered to the chip factory have the highest quality parameters. For several years now, I have been among the best suppliers to Frito Lay, LLC in Grodzisk Mazowiecki. Also in the case of corn I get the high quality grain, which is confirmed by its customers such as WIPASZ S.A.

Increased water capacity of the soil. It was particularly noticeable in 2005 which was a very dry year, and 2013 which was a very wet year.

Much larger numbers of roots and root hairs—an increase of symbiotic microflora in root area (rhizoplan). In the 2005 dry year I got a 30 dt commercial yield of Hermes potato variety on a soil of the 5th class of soil valuation (very low), without irrigation and with low fertilization (N-107, P-35, K-70 i.e. 212 kg NPK/ha)—it was only possible thanks to the use of beneficial microorganisms with probiotic and prebiotic properties for three consecutive years.

Replacement of the putrefactive processes of organic matter in the soil by biologization. In intensive chemical production these processes are an ignored source of the development of plant diseases and pests. The biologization of the seedbed through the use of consortia of beneficial microorganisms turns the putrefactive processes into beneficial processes of fermentation, anti-oxidation and regeneration.

The cultivation of potatoes and corn in monoculture farming. My 13 years of experience indicates that using 60 l/ha ProBio Emy probiotic products on harvest residues mixed with a harrow or plough makes the monoculture of corn possible. Before sowing, I use an initial dose of mineral fertilizers. Grain yields not only do not decrease, but increase every year. Similar mechanisms also allow potato cultivation in monoculture.

Increased natural resistance of plants to diseases and pests—disappearance of beetles (*Elateridae*) mummification of larvae of aphids and Colorado potato beetle.

Measurable economic results

Biologization brings me a higher revenue from the leased farm.

2 927 163 PLN in 2006 and rose to 5 234 848 PLN in 2011 i.e. about 80%.

Summary.

1. Biologization through probiotechnology in the form of natural biological tools (compositions of beneficial microorganisms with probiotic and prebiotic properties) in the cultivation of potatoes and corn in the Agricultural Experiment Station in Chylice has increased the quality and fertility of the soil.

2. These soils enabled me to obtain increased yields of potatoes and corn, while improving their biological quality. In 2006-2011 yields of those plants increased by 39% and 54% respectively, while the high quality has been confirmed by customers. These results were achieved on low quality soils.

3. At the same time, the applications of consortia of beneficial microorganisms to the soil and in the form of spraying plants in combination with green manures and organic fertilizers increased the strength of the fertile power of the soil and its water capacity. This resulted in the elimination sources of diseases and pests in the soil ecosystem. In my case, biologization has reinforced rather than undermined (as agrochemicals do) the natural resistance of potatoes and corn to disease and pests.

4. In 2006-2011 the average availability of phosphorus increased by almost 40% and 77% of potassium, and from 2001 to 2009 I observed more than a twofold increase in humus content. This allowed for a two to threefold reduction of the recommended doses of fertilizers, and in some cases even the total elimination of phosphorous and potassium fertilizers.

5. Increased natural resistance of crops allowed me to significantly reduce the use of pesticides in the treatment of potato tubers and corn seeds together with the amount of spraying during the vegetative period. On average, during 2006-2011 the savings amounted to 84 000 PLN/ha.

6. The use of probiotechnology at all stages of cultivation, in conjunction with the use of green manures brought me in 2006-2011 an average revenue growth of 80%.

7. The mechanism of these great effects achieved by using beneficial microorganisms, as well as the absence of such results in some cases, are not yet fully explained. This requires, however, a wider involvement of scientists to explain them.

8. My practical experience demonstrates the multiple benefits of the use of probiotechnology. I am convinced that it is a viable prospect for getting high and healthy yields for the benefit of the environment and people. I share the view of the German philosopher Hermann Lübbe, who believed that ***"The higher the degree of innovation, the more the old truths and the elements are included in the lifestyle goods."*** **For this reason, the simple biologization of the soil and crops may well serve the innovative economy.**

9. The consistent biologization in my case allows me to visibly reduce the use of chemicals. The European Commission within the CAP 2014-2020 made decreasing of agro-chemicals use its priority for integrated plant protection. However, the common use of terms such as "green technology" or "greening the CAP," make it difficult to understanding their intention. Replacement of these terms by the term biologization (definition developed by the Polish Professor of soil science Lesław Zimny from the Wrocław University of Life Sciences) certainly would facilitate communication.

10. In the Polish rural culture, when something was greening in the pantry it meant that something had to be got rid of as soon as possible.

Jan Marczakiewicz

Member of Ecosystem –Nature's Heritage Association

Participant of the socio-economic movement – HEALTHY EARTH MOVEMENT

Awarded the Sower Award of the HEALTHY EARTH MOVEMENT