



A Drynet Science & Technology Expertise:

Field Participatory Research

**Research on the Effectiveness of Trichoderma in Improving Soil Fertility,
Disease Control, and Reduction of Chemical Fertilizers and Pesticides
Application in Cultivation of Leafy Vegetables in Shahr-e-Ray**

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December 2009**



**EUROPEAN
COMMISSION**



drynet is a project funded by the European Union and supported by The Global Mechanism

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Abstract

With an overall objective of promoting sustainable agriculture and with a biological control approach, the research will conduct an experiment in which Trichoderma fungus will be used in the cultivation of leafy vegetables instead of chemical fertilizers and pesticides. The experiment will be carried out in Shahr-e-Ray – a region in Southern Tehran. The research will be carried out as a field participatory research, a model practice in a framework of Research & Development strategy.

Short-term benefits of the Intensive Agricultural System and Green Revolution propaganda have inhibited the consideration of agricultural soil as a living, sensitive and vulnerable organism and paying adequate heed to the necessity of its protection. Soil, by nature, is a dynamic ecosystem in which substance and energy flow. Water, plants, biological agents, and soil-dwelling organisms are considered as the main components of this system where the coexistence of these components is the main factor regulating the food chains and life cycles. Protecting the biological activity and health of the soil and providing a suitable environment for growing plants is the objective of the soil management in organic systems.

Excessive use of chemical fertilizers and pesticides in ordinary agriculture, particularly use of fungicides for the cultivation of summer crops, has a very harmful impact on the health of the people who use these products. It may also impose heavy costs on the livelihoods of the farmers.

The research aims to examine and evaluate the effectiveness of the use of Trichoderma for soil-related disease control, soil fertility and reducing the consumption of chemical fertilizers and pesticides in the production of vegetables. The research is based on the farm treatments conducted by volunteer farmers at regular intervals along with facilitations made by experts. These treatments are aimed at examining the effectiveness of Trichoderma in fungus disease control in vegetables and improving the biological activity of the soil.

10 farmers and number of facilitators will be empowered to use Trichoderma to the plants and assess the results. They will also try to encourage other farmers to use this method too. Reduction in the use of chemical fertilizers and fungicides in growing vegetables in the pilot region, prevention of land degradation and desertification, production of healthy products and providing a model for sustainable agriculture are among the objectives of the project.

Keywords

Trichoderma, soil, soil fertility, biological control, fungicide, disease, farmer, agricultural ecosystem, Field Participatory Research (FPR), Research and Development (R&D), Farmers Field Schools (FFS)

1. Introduction

Over 4.5 million farmers work on 18 million hectare of land across Iran. Agriculture is the most important economic and livelihood cycle of the families is nearly 80,000 villages around the country. The result is the production of almost 100 million ton of various agricultural products each year. Based on the UN statistics, there are 66 main farming products (41 agricultural and 25 horticultural products) in the world. 7 agricultural products and 15 horticultural products are produced in Iran making it one of the 10 first agricultural producers in the world. The daily consumption of fresh leafy vegetables is high among Iranians. 25% of the pesticides used in the country are applied to these vegetable. This shows the importance of using biological and non-chemical disease control methods.

Application of these methods requires great changes in agricultural information system based on a strategy of developing sustainable agriculture, soil management and empowerment of local farmers. In general, biological factors are more sensitive and responsive to soil management practices (compared to physical and chemical indicators). This is the basis of soil fertility and protection practices and nutrition management in the sustainable agriculture and in organic agriculture, in particular. The sound management of the soil should be based on the management of biological factors. Therefore, development of sustainable agriculture at the community level should be pursued through the integration of various existing factors and exercising comprehensive production management and protection of the agricultural products by empowering the farmers.

The Significance of the Issue

Indirect exposure to pesticides is the result of eating foods treated by pesticides. Based on the length of the exposure to this kind of food, it can lead to the increase of poisonous substances in the body. Use of chemical fertilizers and failure in observing related standards in the production of fruits and vegetables has reached dangerous proportions in Iran and experts are now concerned about the health of the citizens. Iran's rank 122nd in public health in the world (WHO, 2007) which is a very low rank, the reason is malnutrition and failure in appropriate use of chemical pesticides and fertilizers in agriculture and horticulture. It is believed that most of the fruits and vegetables produced in Iran are polluted by nitrate and cadmium (two chemical agents causing cancer and other disease).

Soil health and food security are closely related. Today, it is believed that the low quality of agricultural soil can result from failure in returning to the soil the micronutrients taken from it. Imported phosphate fertilizers which usually have 0.03 mg (per kg) cadmium are not safe to be used in agriculture. In 2007, the amount of phosphate fertilizers imported into the country was twice the amount needed for that year (1 million ton). As a result, 30 ton additional cadmium made its way into agricultural products and underground waters. If 0.02 mg cadmium enters a person's body, it will cause the kidneys to stop working. If it enters the body gradually, it can cause cancer and short stature. Stomach microbes change nitrate into nitrous amine, a dangerous substance causing cancer. Consumption of vegetables, summer crops and underground waters can lead to excessive intake of nitrate. This is a main cause of stomach cancer.

Up to the present time, considerable effort has been made to replace chemical fertilizers and pesticides with biological alternatives. This has usually been welcomed by farmers and local communities. Since using Trichoderma is one of the technologies adopted for replacing the use of chemical fertilizers and pesticides, disease control and improving the soil fertility in organic

agriculture, any technology which can – directly or indirectly – lead to increasing the biological activity of the soil can be studied and investigated for that purpose. Nutritious elements in soil suffer most from the chemical fertilizers and pesticides which gradually degrade the soil texture. Degradation of soil will lead to production of unhealthy products, degradation of agricultural lands, increase of desertification and ultimately, abandoning the agricultural lands. Therefore, application of technologies such as using Trichoderma and other useful fungi and bacteria for preventing land degradation, producing healthy products and preventing disease proves more and more important. Therefore, this research will investigate the application of Trichoderma fungus by using Field Participatory Research (FPR) method, for the purpose of increasing soil fertility, fungi disease control and reduction of the use of chemical fertilizers and pesticides in growing leafy vegetables.

Definitions

- **Target product:** leafy vegetables such as parsley, spinach, fenugreek, coriander, mint, leek, etc;
- **Farming season:** in the target area the farming season starts from the beginning of March and lasts until November of the next year;
- **Duration of the project:** considering the characteristics of Trichoderma (the living agent) and the cold soil in March and April, the cultivation begins from May and goes on until November;
- **Disease:** dominant diseases in the area include: Rhizoctonia, Sclerotinia, damping off, Phytophthora, Verticillium, Peronospora spp, and Anthracnose;
- **Treatment:** examining the effects of Trichoderma in the different experiments carried out by volunteer farmers (3 repetitions);
- **Biological control:** use of biological substances for pest control, disease control, crop nutrition, and soil fertility (including both the protection of biological substances of the soil and development of technologies for improving the biological activity of the soil);
- **Fungicides:** the main fungicides used are: Ridomil, Mancozeb, and Benomyl
- **Fertility:** the fertility of the soil as the result of using Trichoderma (a biological substance) will be compared to the soil fertility caused by chemical fertilizers;
- **Farming ecosystem:** all factors affecting the growth of the (target) product including factors related to plants, climate, management and also living and non-living agents;
- **Field Participatory Research:** participation of local volunteer farmers in the practice of using Trichoderma for disease control and soil fertility improvement aimed at promoting this technology in a participatory way;
- **Research & Development:** a method for community capacity-building and participatory technology transfer in the shortest time possible based on local conditions;
- **Farmers Field School:** a new participatory method for training the farmers on the farm during the farming season.

2. Research Question and Objectives

Questions

- What is the effect of using Trichoderma for disease control in leafy vegetables compared to the use of chemicals?
- How effective is Trichoderma in improving the biological activity of the soil?
- How is Trichoderma used for elimination or reduction of chemicals compared to the control sample (typical conditions)?

Assumptions

- Examining the effect of Trichoderma on disease control;
- Examining the effect of Trichoderma on soil fertility;
- Examining the effect of Trichoderma on reducing pesticide use;
- Examining the effect of Trichoderma on reducing the use of chemical fertilizers.

Overall Objectives

- Producing biological agents at local level for the purpose of application in management practices for growing healthy products and promoting sustainable agriculture
- Prevention of land degradation with emphasis on improving the soil biological activity and reducing the use of chemical fertilizers and pesticides
- Improving farmers' livelihoods as the result of reduction in chemical fertilizers and pesticides use

Specific Objectives

- Disease control in vegetables through non-chemical methods
- Fertility management based on sustainable relations among water, soil and plants
- Capacity-building of local farmers so that they can identify and apply Trichoderma
- Development of a local network of trained farmers for the purpose of promoting the use of Trichoderma and other non-chemical agents in the target area
- Developing an efficient method for protecting natural resources and preventing land degradation
- Improving the livelihoods of the farmers as the result of increasing the biological activity of the soil and reduction of the use of chemical fertilizers and pesticides

3. Methodology/approaches

The methodology of this research is based on Field Participatory Research (FPR) and Farmers Field Schools (FFS) which will be conducted within a framework of Research and Development (R&D). The principles of the research are based on the participation of local farmers and their capacity-building for Integrated Pest and Crop Management (IPCM) and Agro-Ecosystem Analysis in Sustainable Agriculture (AEASA). The needs and priorities of the farmers will be identified and met through practical plans made by them based on the principles of the sustainable agriculture. It is expected that this method will help to reduce the increasing interference of the government in the agriculture and let the farmers solve their problems using their know-how and indigenous knowledge and experience. The government, however, will have a role to play and that is to support the farmers and empowering the local communities.

A 2-hectare farm in Shahr-e-Ray will be selected (as the main farm). Also, 10 other random farms will be selected from among the farms owned by the volunteer farmers for the purpose of the repetitions envisaged in the research. The 2-hectare farm (the main farm) will work as a school where farmers will learn all they need to know about the project. Meanwhile, they will conduct the experiment on their own farms. The two methods for growing vegetables – chemical and biological (using Trichoderma) – will be carried out in all farms. Therefore, there will be 10 repetitions so that the experiment can be tested in 10 different situations. Due to the different conditions caused by different microclimates, soil texture, and even cultural and social conditions of the farmers, the outcome is expected to be very comprehensive.

10 volunteer farmers, 4 experts (in plant protection, farming and plant breeding, soil nutrition, and ecology) and the project facilitator – who will supervise all the stages of the work – will participate in the implementation of the research. Local farmers will be the main investors in this pilot project, since they will be the ones who allow the project to use a 2-hectare farm owned by them. They are also the ones who will actually do the experiment.

4. Results

- Capacity-building and empowerment of at least 10 farmers and a number of facilitators in the target area
- Developing a local network for producing healthy leafy vegetables in Shahr-e-Ray
- Reduction of the consumption of chemical pesticides and fertilizers up to 50% - 100% in the target area and using Trichoderma in 10 leafy vegetables farms

5. Evaluation and Analysis

The volunteer farmers participating in the research will have an important role to play in the process of evaluation and analysis of the data resulted from the experiment. They will constantly monitor the results, take notes and provide reports. Finally, the farmers together with the facilitators and the experts will evaluate and document the information gathered about the effectiveness of Trichoderma based on the questions and objectives of the research.

6. Conclusions

Following this research, a series of discussions were done with interested¹ groups which resulted an agreement to find proper financial sources from possible interested groups to conduct a pilot project through participatory approach to transfer of the model of sustainable agriculture through biocontrol methods of PROBIOMA to Iran.

In case of fund raising, the necessary steps will be taken for the implementation of the pilot project in *Ghooch-hesar*² village (in 10 volunteer farmer's farm)³ which is located in central part of *Shahr-e-Ray*. The main crops which will be taken into consideration in the pilot project will be green vegetables and summer crops which are cultivated in more than 912 hectares in this village. Therefore the implementation of this project will assist all interested groups to examine the effect of Trichoderma on improvement of the biological quality of the soil, controlling soil-dwelling fungal diseases, reduction of pesticides and chemical fertilizers use in the area and producing healthy green vegetables and summer crops through a participatory approach in the area.

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¹ Annex A.

² Annex B

³ Annex C

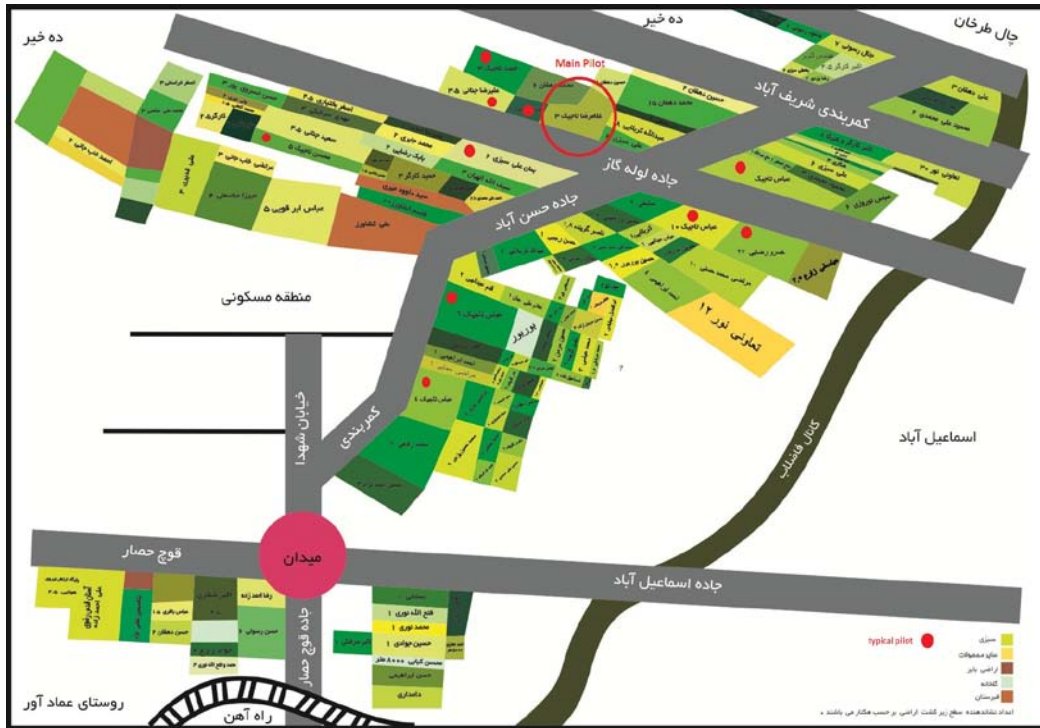
8. Annexes

Annex A.

List of interested groups for conducting a pilot project on “The Effectiveness of Trichoderma in Improving Soil Fertility, Disease Control, and Reduction of Chemical Fertilizers and Pesticides Application in Cultivation of Leafy Vegetables in Shahr-e-Ray”

- Agricultural research Centre of the Scientific- Industrial research Organisation of Iran;
- Agricultural Organisation of MOJA (Ministry of Jihad and Agriculture)of the Shahr-e-Ray district;
- Coordination Office of the Extension of MOJA, Tehran Province;
- Organisation for the Conservation of Plant of MOJA, Tehran Province;
- Local Governor, Shahr-e-Ray;
- Commission of Producing and Development of Organic and Healthy Product;
- Ministry of Health and Medicinal Education;
- The Plant Clinical Centre of Shahr-e-Ray;
- The Islamic council of the *Ghooch-hesar* village and 10 volunteer farmers;
- Centre for Sustainable Development (CENESTA)

Annex B. The location of the pilot farms in *Ghooch-hesar* village



Main pilot	○
Typical pilots	●

Annex C: list of 10 volunteer farmers in the area

	Name of the volunteer farmers
1.	Gholamreza Tajik
2.	Mohsen Tajik
3.	Abbas Tajik
4.	Hamid Tajik
5.	Alireza Janani
6.	Bemane-Ali Sabzi
7.	Ali Sabzi
8.	Khosrow Rezai
9.	Asgar Bakhtiari
10.	Abdollah Karbelai