coffee & climate
enabling effective response

Use of Trichoderma in Seedlings and Nursery

Case Study Background Data		
Tool Category: Adaptation on the farm		**Detail:** Planting Density: - Soil Type: - Shade Regime: - Farming System: - Yield Range (kg cherry ha) ⃠ **rain :** 1500 mm/y
Variety: Arabica		
Climatic Hazard: • Drought • Heat stress		
Expected Outcome: • Higher resilience to heat stress & drought		
Implementation Date: 25.02.14 - 25.04.14	**Altitude:** 1000 – 1500 m **GPS:** 14.635278° N 89.437500° W	**Slope of plots:** ⃠ **Age of trees:** < 5 years
No. Farmers: 9	⃠ **Area under coffee:** 1 ha/farmer	Tested on demo plots

Results

Young coffee trees are vulnerable to drought when transplanted to the field because the roots are still poorly developed. The initiative for coffee & climate looked for alternatives to stimulate the root system and thereby reduce mortality during transplantation. *Trichoderma harzianum*, Trichoderma, a genus of fungi, was identified as a promising tool. It was applied at two production stages: seedlings and nursery. At the seedling stage Trichoderma gave better results than controls: after 60 days, roots were on average 15.4 cm long, whereas control seedlings were 13.7 cm after 60 days.
Trichoderma applied at the nursery stage also gave better results: an average of 17 cm long x 12 cm wide compared to 12 x 9 cm for the controls after 150 days.

Pros & Advantages + Learnings	**Cons, Disadvantages + Things to take into account**
• Better root system • Plants were more healthy • Reduced attack of damping off • Improved root system can improve nutritional absorption	• Cost of application will increase progressively (seedlings to nursery, nursery to plantation) • Access to product is limited by distance • Product needs refrigeration

Acceptability	High	**Effectiveness**	High
Affordability	High	**Timing / Urgency**	High

What is the objective of applying the adaptation option and how do we expect the objective to be met?

Drought and extreme temperatures are two hazards that are affecting many communities in the Trifinio region. One aspect identified in the impacts generated by these hazards is the poor development of the root system. Trichoderma is a fungi that develop a symbiotic (mutually beneficial) relationship with the root system, it helps the plant to increase its ability to uptake water and nutrients and is specially effective against damping off (a disease of seedlings). It is expected that plants treated with Trichoderma develop a better root system which increase the resilience in case of a drought or extreme temperatures.

Description of climatic hazard and associated problem: Through the triangulation process *(see also tool 'risk evaluation')*, drought and extreme temperatures had been identified as a major climatic risks for smallholder coffee farmers in Trifinio. Drought leads to a high mortality of coffee seedlings in new plantations but also poor development of the plant as roots are poorly developed.

Description of expected outcome: Increased plant resilience to drought and heat stress through a better developed root system.

How is the adaptation option applied?

Nr.	Step	Picture
1	Dosage: Seedlings – 28 g of Trichoderma per square meter* Nursery – a mix of 10 g/ litre of Trichoderma, applied at 40 ml per plant	

2	Irrigate as usual Fertilize as usual Spray as usual, it is important to emphasize that Trichoderma inhibits other fungi especially the ones related to damping-off which attack the seedling stage.	
3	Results with seedlings in Guatemala Trichoderma at the left; control on the right.	
4	Results with seedlings in Honduras Trichoderma on the right.	

Implementation framework

The study was implemented by the initiative for coffee & climate (c&c) in collaboration with the farmer organization – ADCASPE – located in Guatemala and the Cooperative "Flor del Pino" located in Honduras. Both cooperatives have some farmers who plant coffee below 1,300 m.a.s.l., which makes them vulnerable to drought.

By evaluating with farmers the various conditions that make them vulnerable to climate change, it was identified that the plants were in poor condition from as early as the nursery stage. Research made by c&c established that an alternative to improve the quality of the plants and especially the roots was the use of *Trichoderma harzianum*, the identified product is distributed by Biological Control Lab of the University Zamorano. Farmers participating in both cooperatives were trained in the use of the product in the demo plots.

Measurement Strategy for effectiveness

The evaluations were made at two different stages of nursery, application at the seedling stage and at the nursery stage when the seedlings are planted into bags.

Seedlings – One treatment (dosage of 28 g/m^2 on day 1) and one control without any product (as farmers usually plant). After 60 days, when farmers usually transplant the seedlings to bags, 50 individuals of each treatment were selected and roots were measured in length and width.

Nursery – After the process of germination the plants are transferred to individual bags where they will receive water, fertilizer and spraying if required. Two treatments, with Trichoderma (dosage of 10 g/litre and 40 ml by plant) and a control (testigo) were established; both treatment and control were managed in the same way (labour, fertilizers and agrochemicals) for 5 months. After this period, 3 plants from the treatment and control groups were washed of soil to reveal the complete root system which was then measured to evaluate the length and width.

Treatments evaluated for both seedlings and nursery were analysed to evaluate average, max and min dimensions. The data was also discussed with the farmer organization and farmers to evaluate their perception about the use of Trichoderma.

Indicator N°1 - Length

Indicator	**Length of the root system**
Definition	a. Measure the length of the seedling's root after 60 days of planting (in cm) b. Measure the length of the root after 150 days (5 months) of treatment in the nursery (in cm)
Purpose	A better developed root system will increase the plants ability to uptake water and nutrients.
Baseline	N/A - first experiment with Trichoderma
Target	Root treated with Trichoderma is 10% longer than the control (testigo) without Trichoderma treatment.
Data Collection	Data had been collected from demo plots with seedlings, it has a control and a treatment of: **Seedlings:** 28 g of Trichoderma/square meter **Nursery:** 10 g of Trichoderma/litre of water – dosage of 40 ml/plant
Tool	Measuring tape and data collection sheet
Frequency	After 60 days of planting and after 150 days of treatment in the nursery
Responsible	M&E Director, c&c Coordinator
Reporting	Farmer (demo plot holder) and the technician measure the root system and fill in the data collection sheet to compare treatment in seedlings and in the nursery with the testigo. Where a camera was available, pictures had been taken as evidence. The results of the comparison are discussed during Farmer Field School meetings and c&c trainings within the farmer groups on the demo plots.
Quality Control	The team jointly defined a procedure to measure root development. M&E and c&c Coordinator evaluate the data to analyze effectiveness.

Indicator N°2 - Width

Indicator	**Width of the root system**
Definition	a. Measure the width of the seedling's root after 60 days of planting (in cm) b. Measure the width of the root after 150 days (5 months) of treatment in the nursery (in cm)
Purpose	A better developed root system will increase the plants ability to uptake water and nutrients.
Baseline	N/A - first experiment with Trichoderma
Target	Root treated with Trichoderma is 10% wider than the control (testigo) without Trichoderma treatment.
Data Collection	Data had been collected from demo plots with seedlings, it has a control and a treatment of: **Seedlings:** 28 g of Trichoderma/square meter **Nursery:** 10 g of Trichoderma/litre of water – dosage of 40 ml/plant
Tool	Measuring tape and data collection sheet
Frequency	After 60 days of planting and after 150 days of treatment in the nursery
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Quality Control	The team jointly defined a procedure to measure root development. M&E and c&c Coordinator evaluate the data to analyze effectiveness.

Measurement Strategy for acceptability, affordability, timing & urgency

Treatments evaluated for both seedlings and nursery were analysed to evaluate average, max and min dimensions. The data was also discussed with the farmer organization and farmers to evaluate their perception about the use of Trichoderma.

Since all the other activities were the same, the cost calculation was based on the additional costs incurred by applying Trichoderma, the results are:

Seedlings – 1000 plants germinate per 1 square meter. The dosage used = 28 grams. One package of Trichoderma weighted 240 grams costs USD 20. The additional cost of using Trichoderma was:

By square meter: USD 2.4

By plant: USD 0.002

Labour: To apply in 1 square meter = 1 hour

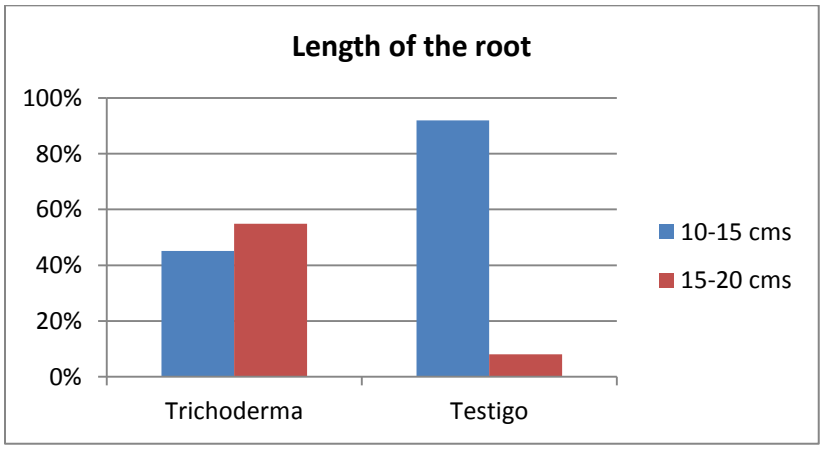
Nursery – 10 grams of Trichoderma per litre with a dosage of 40 ml/plant.

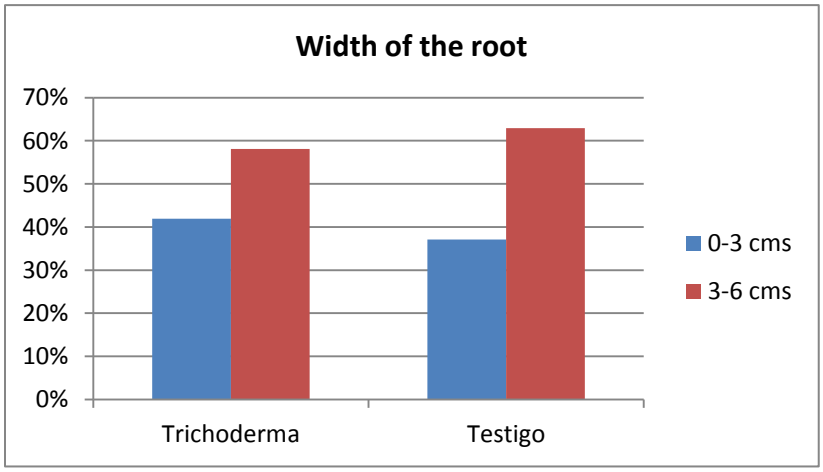
By Plant: USD 0.03

Labour: To apply for 500 plants = 0.5 hour

Main Findings of Case Study

Seedlings: Trichoderma treatment performed better than the control. The coffee roots measured a mean of 15.4 cm with Trichoderma and 13.7 cm for the control. More than 50% of the roots are longer than 15 cm with Trichoderma, whereas for the control more than 90% ranged between 10 and 15 cm. All measurements were taken after 60 days of planting.





Trichoderma applied at nursery performed better than controls. Coffee roots measured a mean of 17 cm with Trichoderma, for the controls it was 10 cm. The root width was 12 cm with Trichoderma against 9 cm for the control.

Acceptability					
Leading Question: To what extent did farmers readily accept this tool as useful for implementation and implement it as planned?					
High	X	**Low**		**Don't Know**	
High: Farmers readily accepted this tool for implementation and continue to implement it as planned.			**Low:** Farmers generally did not accept this tool; *Or* the tool was met with resistance later on, even though farmers initially accepted it.		
Please Comment:					
If there was resistance to adopting this tool, why?			-		
If farmers discontinued tool implementation later on in the process, even though they initially accepted it, Why?			-		
Did this tool have any external issues or impacts (positive or negative) which influenced its acceptability? (community, value chain?)			-		
Any other comments:			Main issue with Trichoderma is distribution, as the regions where it is produced and where it can be used are at a distance of 500 km.		

Affordability					
Leading Question: Are the costs of the tool affordable to farmers taking into account the initial investment, maintenance costs and the availability of inputs?					
High	X	**Low**		**Don't Know**	
High: The initial investment and the maintenance costs of this tool are affordable to farmers from their regular operations and the time it takes to recover the investment is reasonable to farmers. *Inputs (e.g. labor, electricity..) are available when they are necessary so that no extra costs are incurred from timing related issues.*			**Low:** The initial investment or the maintenance costs of this tool go beyond what is affordable to farmers from their regular operations *or the amount of time it takes to recover the investments are unreasonable to farmers*.		
Please Comment:					
Are there any external costs? (to society or environment?)			No		
If costs are high because inputs are not available, what inputs? And why?			The application of Trichoderma should be done in the seedling and not in the nursery stage, to reduce the impact on cost production by plant.		
Any other comments:			-		

Effectiveness					
Leading Question: Does the tool provide the expected benefits to farmers?					
High	X	**Low**		**Don't Know**	
High: The objective of the tool has been met for the farmers.			**Low:** The tool did not fulfill its objective entirely.		
Please Comment:					
What benefits did farmers expect from this tool?			Better root system which will lead to: Less stress by drought Improved access to nutrients Reduced attack of damping-off disease		
If the objective has not been met, why?			-		
Have there been any significant external issues which influenced the effectiveness (positive or negative) of this tool? Please explain.			-		
Any other comments about effectiveness			Further analysis on development of plant during plantation the crop cycle is needed.		

Timing / Urgency					
Leading Question: Is the amount of time that this tool takes to implement (from starting implementation until benefits accrue) reasonable to farmers?					
High	X	**Low**		**Don't Know**	
High: The tool takes a reasonable amount of time to implement (taking into account the coffee growing season, inputs necessary, preparation time and implementation time); *And* this tool accrues the effects expected within a reasonable amount of time.			**Low:** It takes too long to implement this tool (taking into account the coffee growing season, inputs necessary, preparation time and implementation time); *Or* it simply takes too long for this tool to accrue benefits.		
Please Comment:					
If implementation takes too long why?			-		
Any other comments about timing:			Further development is needed.		