

Costs and key points of producing and applying biofertilisers

The production and application of biofertilisers mainly has three types of costs: (1) costs of obtaining mountain microorganisms as the basis of the biofertiliser, which are obtained from forest humus and are produced in closed containers; (2) costs of producing the biofertiliser, which is obtained from these mountain microorganisms in a closed container; and (3) costs of applying the biofertiliser to the ground, which can be done by foliar application or via irrigation.

■ Quantification of the costs of producing and applying biofertilisers

The quantification of the production and application of biofertilisers (Figure 1) is based on calculating three different types of costs:

1. Cost of obtaining mountain microorganisms as a basis for the biofertiliser.
2. Cost of producing the biofertiliser.
3. Cost of applying the biofertiliser in the field.

Next, we will describe the different alternatives that we have analysed for each of these processes, indicating the costs they represent and their variability (Table 1).

1. Cost of obtaining mountain microorganisms as a basis for the biofertiliser. This cost includes the time it takes to collect the humus sample that will be used as a raw material for the microorganisms in the forest, the materials needed to achieve the mixture, and the time dedicated to obtaining the homogeneous mixture. In Polyfarming, these mountain microorganisms are produced in 200-l containers and all subsequent calculations refer to producing a complete container.

- To produce a container of mountain microorganisms like the one described, about **120 l of humus from the forest floor** is needed (slightly more than half because it is then compacted). The time spent collecting the humus sample from the forest floor can be estimated at **0.5 h of work** by one person. The forest must be close to the farm, because otherwise we have to count the time to look for and transport the humus sample.

- In addition to humus, which in principle has no cost, for the production of the mixture that fills the used container (200 l), a similar amount of **rice bran** is needed (**120 l**, which is equivalent to about 28 kg, €0.2-0.3/kg), and **10-20 l of molasses** as an energy source (at €0.5/l).

- These three ingredients (sometimes water is added) are combined until a homogeneous mixture is obtained. The time required to get it and fill the entire container with it is **2 h of work** for two people. After a month of being hermetically sealed, the product is obtained.

2. Cost of producing the biofertiliser. In this case, the biofertiliser is obtained from mountain microorganisms. The costs of producing it include the drums in which they



Figure 1. Applying biofertilisers at Planeses farm. Photo: Ángela Justamante.

are produced, the remaining ingredients required and the time to prepare the biofertiliser.

- Biofertilisers are produced in **200-litre plastic drums**, with a hose connected to a valve with the end inside a bottle filled with water, to evacuate the gases formed. The cost of each of these structures is **€60-70 if they are new** and **€10-15 if they are recycled**.

- To complete the content of a drum, a mesh bag is required into which a **40 kg sample of mountain microorganisms** and the following ingredients are introduced: **20 l of cow's milk serum**, which in our case is self-produced (if not, it can be obtained free from a cheese factory), **4 l of molasses (€0.5/l)**, **4 kg of rock flour** (obtained free from a quarry), **4 kg of ashes** (obtained from a wood stove) and **180 l of water**.

- The time to mix all the ingredients and obtain a homogeneous mixture, and the time to fill the drum contents in closed containers is **0.25 h for each 200-l drum**.

3. Cost of applying the biofertiliser. This cost includes the time spent applying it to crops, which can be done by foliar or irrigation means.

- The foliar application of the biofertiliser is carried out by spraying with a full backpack up to 20 l (if not, it weighs too much), which, if the orchard is large, must be with a motor. We have estimated that with the backpack the biofertiliser can be applied at a speed of **1 ha/h**, counting a speed of **6 km/h** (one-person walking) and a width of **1.5-1.6 m**. To this should be added that each time the backpack is emptied, it must be refilled (20 minutes in total each time).

- The application of biofertiliser through irrigation is very fast, it simply requires a pump to inject it into the irrigation water pipe.

From these considerations, we can establish a series of simple calculations to estimate the **costs global production and application of biofertilisers** in agricultural land. **The overall cost is the sum of three costs:**

$$C_{\text{total}} = C_{\text{obtaining}} + C_{\text{production}} + C_{\text{application}}$$

Obtaining mountain microorganisms as the basis of the biofertiliser (for a 200 l container):

$$C_{\text{obtaining}} = 0.5 \text{ h} \times \text{Salary/hour (collection of 120 l of humus)} + 28 \text{ kg} \times 0.2 \text{ €/kg (rice bran)} + 15 \text{ l} \times 0.5 \text{ €/l (molasses)} + 2 \text{ hour/worker} \times 2 \text{ workers} \times \text{Salary/hour (preparation of the mixture)}$$

Production of biofertiliser (per 200 l drum):

$$C_{\text{production}} = \text{€} 15 \text{ (reused drum)} + 20 \text{ l} \times \text{€} 0/\text{l (cow serum)} + 4 \text{ kg} \times \text{€} 0.5/\text{l (molasses)} + 4 \text{ kg} \times \text{€} 0/\text{kg (rock meal)} + 4 \text{ kg} \times \text{€} 0/\text{kg (ash)} + 0.25 \text{ hour} \times \text{Salary/hour (preparation of the mixture and packaging)}$$

Application of the biofertiliser (in one ha of crops), can be in two ways:

$$C_{\text{application (foliar way)}} = 1 \text{ h/ha} \times \text{Salary/hour (foliar application with a backpack filled up to 20 l)}$$

$$C_{\text{application (irrigation)}} = 0.25 \text{ h} \times \text{Salary/hour (application through irrigation)}$$

■ Considerations on the optimal strategy for producing and applying biofertilisers

We must consider the following key points in the production and application of biofertilisers:

- **There are many types of biofertilisers**, so costs and techniques can vary depending on the biofertiliser produced.
- In general, the key point of biofertilisers is that they are

produced by the farmers themselves with very **low costs and from materials from the environment or at a very low price.**

- There are very important differences in the mode of application and the total amount of biofertilisers to apply, and in general the information found on their impact on crops is not very extensive.

Parameter	Unit	Value used	Variability and causes
Amount of soil humus to produce mountain microorganisms	l/drum 200l	120	It may be something more because it compacts a lot.
Time to collect soil humus	h	0.5	It depends on the distance to the forest
Amount of rice bran to produce mountain microorganisms	l/drum 200l	120	As in the case of humus, when compacting it can accommodate more
Amount of molasses to produce mountain microorganisms	l/drum 200l	15	It can range from 10 to 20
Time to get the homogeneous mixture of the container	h/2 workers	2	2-3 range if lacking experience
Cost of the drum prepared to produce biofertiliser	€/drum 200l	15	This is the price of the reused drum, if it is new it can be worth €60-70
Amount of microorganisms to produce biofertiliser	kg/drum 200l	40	-
Amount of cow's milk serum to produce biofertiliser	l/drum 200l	20	Milk can also be used
Amount of molasses to produce biofertiliser	l/drum 200l	4	-
Amount of rock meal to produce biofertiliser	kg/drum 200l	4	-
Amount of ashes to produce biofertiliser	kg/drum 200l	4	-
Amount of water to produce biofertiliser	l/drum 200l	180	It must be chlorine-free water
Time to produce the fertiliser	h/drum	0.25	-
Speed of applying fertiliser by spraying with a backpack	ha/h	1	It is a fully estimated calculation that can vary considerably depending on the applicators and the application conditions
Time to apply biofertiliser to the irrigation system	h	0.25	It is very quick, just a pump connection to inject it into the irrigation water.

Table 1. Parameters used to calculate the costs of forest harvesting, indicating the values used in Polyfarming and any variability that can occur in these values.