GROWING OYSTER MUSHROOMS ON CATTAIL

Waterschap Aa en Maas

Interreg North-West Europe
Carbon Connects
European Regional Development Fund

VERBRUGGEN PADDESTOELEN

VAN DE CROMMERT PROJECTS & INNOVATIONS

Inhoud

This project was funded by the Water Board Aa & Maas and the Interreg NWE project "Carbon Connects" and implemented by Verbruggen Paddestoelen and Van de Crommert Projects & Innovations.

Introduction

A large part of the management area of the Water Board Aa and Maas consists of high sandy soils. Due to climate change, this area is struggling with drought and peak precipitation. Longer drought periods and peak precipitation occur more often. The water board wants to use measures for drought control and water storage to organise the water management for entrepreneurs, residents and nature in the best possible way.

Growing alternative crops, like cattail (*Typha angustifola* and *Typha latifolia*) on wet soils may be one solution to cope with climate change in the lower parts of the landscape and water system and next to wet nature reserves. Part of this project is a test on a farm scale, in which cattail is used as an alternative substrate for biological oyster mushroom cultivation, partly replacing wheat straw. The consequences for the production process and the yields are examined.

The company Verbruggen Paddestoelen, with plants in Erp and Uden, is an important project partner in order to close the small cycle in North Brabant as a potential customer.

Goal

Within this exploratory trial, the main objective is to investigate the effects of the cattail on the oyster mushroom fungus. In other words, do oyster mushrooms grow on a substrate made of cattail? The reason for this is that earlier tests by the WUR show that oyster mushrooms do not always thrive on substrates of water plants. The hypothesis is that these plants have developed a natural defence against fungi because they are growing in the water.

In addition to this test of principle, it is important to see to what extent contaminants accumulate in both the cattail and the oyster mushrooms. Both organisms are known for the fact that contaminants such as heavy metals accumulate in the product.

Implementation

In order to perform a good comparison test with existing substrates, the cattail should be delivered sufficiently dry to Verbruggen Paddestoelen. The ideal moisture content is between 15 - 20%. Subsequently, a substrate is made from the cattail fibre based on the expertise of Verbruggen Mushrooms. This substrate is pasteurised in the existing plant and grown in a climate cell together with a standard biological substrate.

During this process, the steps are recorded and it is possible to evaluate how the cattail substrate compares to other substrates. Because the trial is carried out on a small scale, no statement can yet be made about the final product efficiency of the cattail substrate. Furthermore, based on these processes, an estimate can be made of the purchase price of the cattail in relation to the reference wheat straw.

Research questions

Ultimately, this exploratory project will answer the following research questions:

1. Does an oyster mushroom fungus (*Pleurotus*) develop on a substrate of dry cattail fibres?
2. Are the oyster mushrooms grown on the cattail substrate suitable for human consumption?
3. What is the yield price for the cattail that can be realized based on the first product yields?
4. What are useful next steps based on this exploratory research?

Project report

In order to be able to start a test with oyster mushroom substrate made of cattail, it is important that in a first instance the material is delivered sufficiently dry. In this way, remaining plant juices and other moisture have no negative effect on the development of the oyster mushroom fungus. Unfortunately, it was not possible to supply the cattail fibre sufficiently dry. The first analysis showed that the product had a moisture content of approximately 80%. The main reason for this was the large amount of snow and ice that was still present in the product.

After consultation with Aa and Maas it was decided to dry the cattail in two batches, one consisting of *Typha latifolia* and the other of *Typha angustifolia*. The first batch of product was sent without further processing to Bouwgroep Dijkstra Draisma, who use the cattail fibre as a sustainable alternative insulation for house building and . The second batch of cattail (*Typha angustifolia*) was first reduced in size and then dried. Part of this cattail was delivered to Kompetenzcentrum 3N in Werlte, Germany, which is investigating whether the fibre is suitable as a substitute for peat in potting soil. The remainder is used by Verbruggen Paddestoelen as oyster mushroom substrate.

Pre-treatment

Drying

In order to get the cattail sufficiently dry for further processing, use was made of a drying installation in which sustainable heat was used to dry the cattail. The supplied material consisted of two batches, which were also dried separately. The last batch has been reduced in size before drying, more about this in the next paragraph.

Figure 1 - Mobile drying container with sustainably generated heat

Figure 2 - Leakage of snow

Shredding

During the sampling, it appeared that the product after shredding had a nicer structure than the dry, non-shredded product. Below two pictures to illustrate this. On the left picture, the cattail shredded in dry condition; a lot of dust and no homogeneous mixture. On the picture on the right, the cattail shredded when still wet; a nice homogenous mixture with a loose structure.

In the end, the hammer mill, which is normally used for shredding wheat straw, was also used to shred the cattail.

Figure 3 - Dry shredded cattail Figure 4 - Wet shredded cattail

Figure 5 - Shredding on an industrial scale

Substrate production, cultivation and harvest of the oyster mushrooms

To be able to make the right quality of oyster mushroom substrate some steps are necessary, mainly realising the right moisture content and the effective pasteurisation of the mixture by means of temperature. Below a process description by means of pictures.

Step 1 - Bringing the moisture content at the right level

A sample of the material is taken beforehand and the required moisture is added on the basis of this sample. A homogeneous mixture is then created in a mixing installation, where it is important that the material actually absorbs the moisture. After this step, the mixture is packed in small, ventilating bags so that the pasteurisation process can proceed smoothly.

Figure 6 – Cattail fibre at the right moisture level

Step 2 - The pasteurisation process

The bags are placed in a separate cart in the pasteurisation tunnel, separately from the other substrate. In this way, we can be sure that the two streams are not mixed up. By controlling the climate in the tunnels in this way, a situation is created in which the substrate is pasteurised.

Figure 7 - The cattail mixture in the pasteurisation tunnel

Step 3 - Inoculation of the substrate

After the pasteurisation step, the sterile substrate is inoculated with the oyster mushroom fungus. This fungus has a head start on the other spores present in the substrate and will therefore develop best under the right conditions. Immediately after grafting, the substrate on which the oyster mushrooms will grow later is packed.

Figure 8 - The cattail substrate in the storage hopper and producing the packets

From the 90 kilograms of dry cattail fibre at the beginning, 220 kilograms of substrate was eventually made, divided into 18 packets. The packet weight is slightly lower than for a straw substrate, but this can be explained by the different structure of the material.

Step 4 - Growing the substrate

In this phase, the substrate is placed in a cultivation cell and the right climate is created to ensure that the fungi can develop properly. In this case, the 18 packages of cattail are placed in a standard cultivation cell and have undergone the same treatment as the packages on standard straw substrate.

Figure 9 - Packets in standard cultivation cell during the growth phase

Step 5 - Harvesting the oyster mushrooms

About 18 days after the packets were placed in the cell, the first budding of oyster mushrooms took place. Another 5 days later, the first oyster mushrooms were picked from the packets. This development is similar to the packets with standard straw substrate. At first sight, the yields of the oyster mushrooms seem to be roughly the same as those of the standard straw substrate, but because only a very small trial was done, no significant statement can be made about this.

Figure 10 - Budding and further development

Figure 11 - Ready for harvest

Sampling and accumulation of harmful substances

Because both cattail and mushrooms have the property to accumulate harmful substances, it was decided to take a sample of the material at various stages in the process. In this way, it can be determined whether the cultivated oyster mushrooms grown on cattail can be sold for human consumption.

Sampling of cattail

From the field, samples of the two cattail species (*Typha angustifolia* and *Typha latifolia*) were delivered to Verbruggen Paddestoelen. It was decided to analyse both samples for pesticides and heavy metals. The table below shows the results of this analysis. It can be seen that no pesticides were detected in the material and that the values for heavy metals are below the maximum residue limit (MRL).

	***Typha angustifolia* (mg/kg)**	***Typha latifolia* (mg/kg)**	**MRL EU (mg/kg)**
Pesticide (LC-MSMS)	-	-	
Heavy metals (ICP-MS)			
Arsenic	<0,02	0,12	
Cadmium	0,031	0,039	
Chromium	0,44	1,1	
Copper	3,1	4,0	20,0
Mercury	<0,01	<0,01	0,05
Lead	1,2	1,8	
Nickel	0,35	0,58	
Zinc	15	14	

Sampling oyster mushrooms

Based on the sampling of the cattail, it was decided to analyse the oyster mushrooms for heavy metals only. The table below shows the results.

	Oyster mushrooms on cattail (mg/kg)	**MRL EU (mg/kg)**
Arsenic	0,19	
Cadmium	0,012	0,2
Chromium	<0,02	
Copper	0,72	20
Mercury	<0,01	0,05
Lead	<0,01	0,3
Nickel	<0,05	
Zinc	5	

None of the measured values exceeds the applicable MRL. It can even be seen that the oyster mushrooms have a lower value compared to the pure cattail. To make a definitive statement on this, additional research is necessary. This sampling shows that the oyster mushrooms in any case meet the applicable requirements and are therefore suitable for human consumption.

Results

Aim of the project was to be able to formulate an answer to the following research questions:

1. Does an oyster mushroom fungus (*Pleurotus*) develop on a substrate of dry cattail fibres?
2. Are the oyster mushrooms grown on the cattail substrate suitable for human consumption?
3. What is the yield price for the cattail that can be realized based on the first product yields?
4. What are useful next steps based on this exploratory research?

*Does an oyster mushroom fungus (*Pleurotus*) develop on a substrate of dry cattail fibres?*

This project shows that an oyster mushroom fungus can develop on a substrate made of dry cattail fibres. In this experiment, the cattail fibres were first dried to a moisture content of 20%, so the answer to this question can be affirmative. However, it is hypothesised that with a wet substrate, the remaining plant sap has a negative result on the development of oyster mushrooms.

Are the oyster mushrooms grown on a cattail substrate suitable for human consumption?

The chemical analysis of the oyster mushrooms shows that the oyster mushrooms from this test are suitable for human consumption. The analyses do not show any undesired accumulation of heavy metals.

What yield price for the cattail can be realised based on the first product yields?

Assuming that the substrate based on cattail has the same yield as the standard straw substrate, this automatically means that the dried cattail fibre can be purchased for the same price as straw. In practice this means that the reference prices below can be used. Condition for this is that there are no contaminants in the product, and that no chlormequat and mepiquat is used during the cultivation.

Reference prices and specifications			
Wheat straw delivered OOS*	115	[€/tonne]	* OOS=out of season (October-March)
Wheat straw delivered IS**	75	[€/tonne]	** IS = in season (April-September)
Wheat straw moisture content	15	[%]	
Density on delivery	185	[kg/m3]	

Based on this exploratory research, what are useful next steps?

Within the scope of oyster mushroom cultivation on a cattail substrate, in principle several follow-up steps can be defined. This research shows that it is possible to grow oyster mushrooms on dry cattail fibre. However, it is also known that the drying costs are so high that the reference prices that can be paid are not sufficient to cover these costs. A possible next step would therefore be to set up research to determine what the maximum moisture content could be for a successful cultivation. This would be done using the existing harvesting and processing techniques. If, for example, a maximum moisture content of 30% would still yield sufficient results, the crop could be harvested during a frost period. At that moment a yield could be obtained from the field with little cost.

Another approach is to develop a technique in which the cattail is delivered wet, but processed in such a way that it can still be processed. This would require a different pasteurisation technique, which is currently still in the development phase. Cattail could be one of the raw materials to test this technique on a larger scale.

Conclusions and recommendation

Oyster mushrooms can be grown on a substrate of cattail, provided that it meets the established condition of a maximum of 20% moisture. To be able to make a statement at higher moisture levels, more extensive research is necessary.

Why is it interesting to look at cattail in oyster mushroom substrate? With the help of this application a guaranteed market can be developed and the basis can be laid for markets with a higher gross yield of the product. In this way, a start can be made on the cultivation of cattail in areas with an increased water level.