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D 1.1
Headspace Collecting Device

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JKI

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Dissemination Level		
PU	Public, fully open, e.g. web	
CO	Confidential, restricted under conditions set out in Model Grant Agreement	X
CI	Classified, information as referred to in Commission Decision 2001/844/EC.	

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Deliverable name:	Headspace Collecting Device (PurPest Project Workshop)
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Abstract

This document briefly describes deliverable D1.1, the portable 6-channel headspace collecting device which ensures an exact collection of relative quantities of volatile organic compounds (VOCs) in headspace samples. This device was custom designed for the PurPest project.

Public introduction[1]

The need to control new pest invasions and already established pests such as *Phytophthora ramorum*, *Spodoptera frugiperda*, *Helicoverpa armigera*, *Halyomorpha halys*, and *Bursaphelenchus xylophilus* in the EU have lead to increased pesticide use in the EU. One of the ambitious goals of the EU is to reduce the use of pesticides by 50%. The PurPest project aims to develop, validate and demonstrate an innovative sensor system prototype (SSP) to detect pest-specific volatile organic compounds (VOCs) and thus identify five different target pests to reduce pesticide inputs and stop the establishment of the pest in the EU.

To detect and identify pest-specific VOCs, it is necessary to first develop and build an headspace sampling device for collecting the VOCs in the field and laboratory under different abiotic stress conditions. The important challenge is to be able to capture and identify the relevant VOCs associated with the different pests before the SSP can be built. The portable 6-channel headspace sampling device we are describing here, ensures an exact collection of relative quantities of VOCs in headspace samples. The advantages of the portable 6-channel headspace sampling device are light weight, mass flow range between 0.1 to 1.0 L/min, simultaneous sampling and collecting data such as date and time, ambient temperature, humidity, operational data (mass flow speed and sampling volume) during the collection of the VOCs. Using the portable 6-channel headspace sampling device will help to identify and determine the pest-specific VOCs as biomarker compounds for the SSP.

[1] According to Deliverables list in Annex I, all restricted (RE) deliverables will contain an introduction that will be made public through the project WEBSITE

TABLE OF CONTENTS

Page

1 INTRODUCTION

The PurPest project aims to develop an innovative sensor system prototype (SSP) to detect pest-specific volatile organic compounds (VOCs) and thus identify target pests. Volatiles emitted by pests and infected plants are usually found at low concentrations. However, identification of the VOCs as biomarkers is a complex challenge. An innovative headspace collecting device (HSCD) can help to capture the relevant VOCs. Therefore, the HSCD, as environment-friendly, easy to implement and versatile tool, has high potential to capture the relevant VOCs which could be use as biomarkers.

1.1 Purpose of the workshop

The aim of HSCD workshop was to introduce our self-developed innovative headspace collecting device enabling an exact collection of relative quantities of VOCs in headspace samples to the PurPest members involved in VOC collections (Figure 1). The technical aspects of the device were presented by Ralf Kunath (FLUSYS GmbH). The handling of the device in the lab and field and the data storage and analysis were demonstrated by the JKI staff and trained with workshop attendees.

JKI, partner 4 of PurPest, was in charge of this deliverable (D1.1), whose deadline was set for June 30, 2023. The lead participant along with JKI employees were involved in organizing the workshop (information, headspace sampling, pictures, etc.) and in approving the collection of VOCs of *Halyomorpha halys* and pear trees by the HSCD.

Figure 1: Photo of the PurPest workshop presenting the headspace collecting device.

2 HEADSPACE COLLECTING DEVICE

The headspace collecting device (HSCD) was developed by Jürgen Gross (JKI) together with FLUSYS GmbH, Offenbach, Germany. It is a derivative of a prototype formerly described (Rid et al. 2016; Gross et al. 2019) and consists of six parallel odor collection systems which are mounted in a trolley suitcase, connected by tubes, and wired electrically (Figure 2). The device was completely designed by Flusys GmbH and built in a small series of seven pieces exclusively for the PurPest project. It is robust, can be transported, for example, as a piece of luggage in an aircraft, on a tractor or the loading area of a pick-up truck and is intended for outdoor use. It is CE compliant, has a one-year warranty and comes with an English-language instruction manual. It can be operated from a 240 V socket or by means of an external power supply.

The HSCD consists of six vacuum pumps (KNF Neuberger GmbH, Freiburg, Germany) each connected to a mass flow controller (Bronkhorst High Tech B.V., AK Ruurlo, The Netherlands). Both flow rate and total collected air volume were programmed using an LCD display. In addition, date and time, ambient temperature, and humidity are collected by the HSCD during the sampling VOCs. To prevent cross contamination, there are no connections between single odor collection systems.
There are two different sampling modes possible: an open loop (OLS) and a closed loop sampling (CLS) mode. An important difference between the two sampling modes is that if oven bags are used in OLS mode, they can shrink, which can cause injury to the plants. This does not happen in CLS mode.

Figure 2: Portable 6-channel headspace collecting device (HSCD) for collecting VOCs.

3 HEADSPACE SAMPLING

To detect and identify plant-pest specific VOCs, parts of the test plant and or individual pests were wrapped in oven plastic bags or placed in glass containers as described by Rid et al. (2016). Using clean air filter cartridges (ICAF 2X6, Sigma Scientific, Micanopy, USA) streams of ambient air were purified. Then each stream of purified air, controlled by the headspace sampling device, was pumped through each bag/bottle until it reached the final volume. The final air volume can be set between 0.1 to 1.0 L/min. Volatile organic compounds from headspace sampling were trapped in stainless steel, prepacked sample tubes with Tenax TA35/60 sorbent (Markes, Neu-Isenburg, Germany). Finally, sampled VOCs were analyzed by coupled thermal desorption-gas chromatography–mass spectrometry (TD-GC-MS) in a separate system.

During the workshop, VOCs of pear trees and the brown marmorated stinkbug (*Halyomorpha halys*) were sampled by the HSCD in both OLS and CLS mode (Figure 3 & Figure 4) and were analyzed by a thermal desorption device (TD) connected to a GC–MS.

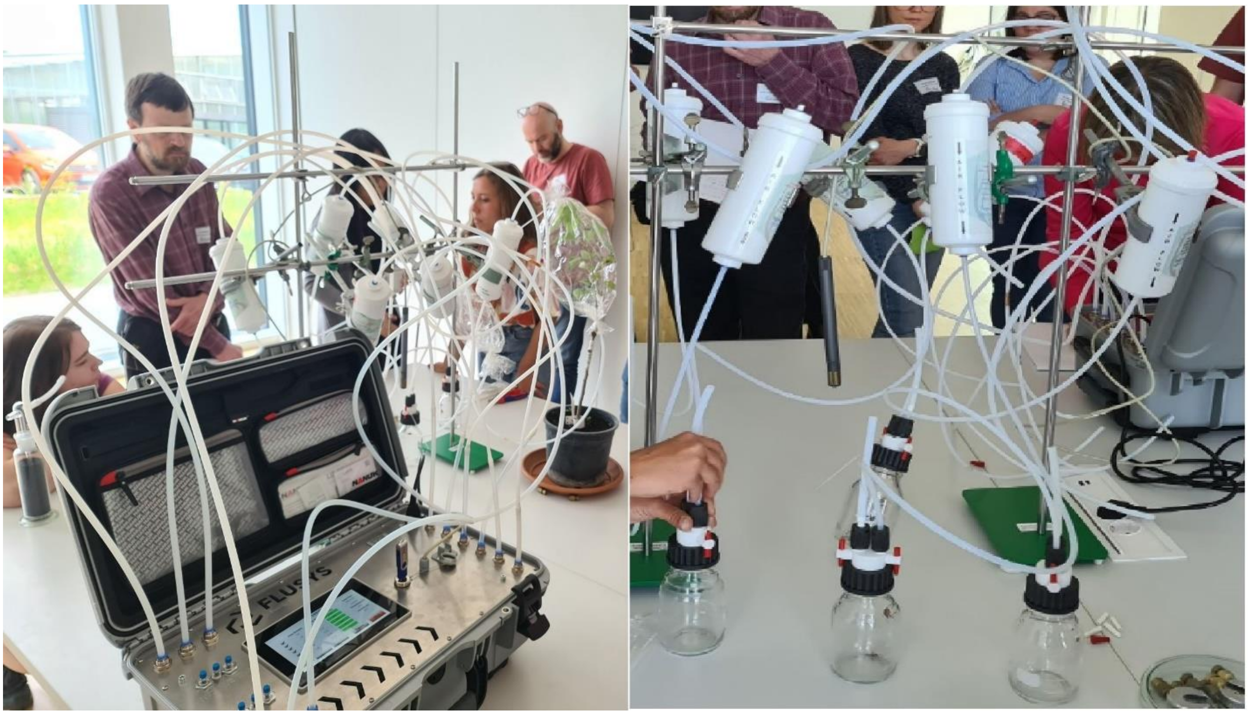

Figure 3: Collection of VOCs of *Halyomorpha halys* using the HSCD in the CLS mode.

Figure 4: Portable 6-channel headspace sampling device for collecting VOCs of pear trees in the OLS (right side) and CLS (left side) modes.

4 CONCLUSION

The headspace sampling technique described here can be used to collect a wide range of volatile organic compounds from various materials such as plants, pests, air and soil. The innovative HSCD, introduced for the PurPest project, has high potential to capture the relevant VOCs which could be used as biomarkers for the SSP.

During the PurPest workshop, VOCs of pear trees and *Halyomorpha halys* were successfully sampled by the HSCD. The function and handling of the device were explained to relevant PurPest members, who were trained in using the HSC during the workshop. The sampling methods for the different target pests have been discussed, enabling the relevant partners to operate the device successfully on their own. The HSCD devices were mounted by FLUSYS Company and delivered to the project partners by the end of June 2023.

5 REFERENCES

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