

CROPINNO

STEPPING UP SCIENTIFIC EXCELLENCE AND INNOVATION CAPACITY FOR CLIMATE-RESILIENT CROP IMPROVEMENT AND PRODUCTION

Grant Agreement No 101059784

D1.1 – First report from workshops, Training Schools and STSMs



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EXECUTIVE SUMMARY

First report from workshops, Training Schools and STSMs is a deliverable of the CROPINNO project, funded as a HORIZON Coordination and Support Action type by the European Commission under its Horizon Europe (HE) Programme. It is produced in the scope of Tasks 1.1. Scientific workshops, 1.2. Training Schools and T1.3. Short-Term Scientific Missions within Work Package 1: Strengthening scientific capacity. This document summarizes the activities completed within those three Tasks till the end of the first reporting period (M15).

The Report describes scientific workshops, training schools and short-term scientific missions organized within the first reporting period and in accordance with D6.1 Mobility Plan. The Report includes the following:

- Reports from workshops,
- Report from Training Schools (TS),
- Report from Short-Term Scientific Missions (STSM)

The First report from workshops, Training Schools and STSMs was drafted by IFVCNS, which is the leader of the respective tasks, with input from all partners.

1. INTRODUCTION

The main objective of the CROPINNO project is to step up and stimulate scientific excellence and innovation capacity of IFVCNS in the field of climate-smart crop improvement and production and enhance its ability to respond and create innovative solutions for the challenges that agriculture faces - climate changes and need to feed the increasing population. This will be achieved by creating a synergistic research environment with internationally leading institutions: Universität Rostock (UROS), Università degli studi di Padova (UNIPD), Forschungszentrum Jülich GmbH (FZJ) and Agencia Estatal Consejo Superior de Investigaciones Científicas - Instituto de Agricultura Sostenible (CSIC). These partners cover gap areas of IFVCNS (multi-omics, phenotyping, data analysis) and enable IFVCNS to expand its skills and innovation capacity and promote its autonomy to collaborate with farmers and industry as well as promote advanced innovation transferable to relevant stakeholders in the agri-food sector. Finally, CROPINNO will enable IFVCNS to develop a centre of excellence for climate-resilient crop production and improvement in the Western Balkans region. In order to achieve this objective(s), diverse training activities are envisaged in the CROPINNO project proposal and will be given in detail in this document.

2. DESCRIPTION OF MOBILITY PLAN

The workshops, TS and STSMs are conducted through activities within WP1 Strengthening scientific capacity and are expected to contribute to the realization of CROPINNO **OBJECTIVE 1 - Improve scientific excellence capacity at IFVCNS in the use of phenotyping and multi-omics in creation and development of climate-resilient crops** and **OBJECTIVE 2 – Strengthen creativity and innovation capacity by development of new collaborations with R&I Institution**, as well as achievement of the **Expected Impact 1: Improved excellence capacity of the coordinating institution in the particular field of research.**



2.1 Scientific Workshops

From M1 to M15 two scientific workshops were organized (**Table 1**), with combined participation of IFVCNS researchers and researchers from the host and other institution partners, thus exposing IFVCNS researchers to new ideas and research practices. In total, 21 IFVCNS researchers participated in both workshops.

Table 1 Scientific Workshops executed within the first reporting period of CROPINNO

Title	Duration	Location	Provider	No. particip. from IFVCNS	Date
Introduction to plant epigenomics	2 days	UNIPD	UNIPD	5	23-24/02/23
Application of sensors and image analysis as tools for plant phenotyping	2 days	CSIC	CSIC	16	25-26/10/23

2.1.1 Introduction to plant epigenomics

This workshop had the aim to introduce plant chromatin dynamics and epigenetic mechanisms. After a short presentation of all the attendances at the beginning of the workshop, eight lectures were presented in two days to give a panoramic view about the role of chromatin organization and epigenetic mechanisms in controlling gene expression and phenotypic traits in plants and crops. The workshop program is given in **Annex 1**.

UNIPD successfully organized the first CROPINNO workshop in 2023. The workshop was attended by the 25 participants, as planned in the Mobility Plan. The specificities of the UNIPD Workshops were to engage participants in learning how to investigate epigenetic mechanisms in crops, formulate productive ideas on the exploitation of epigenetic diversity in breeding programs and to exchange work ideas with all participants.

The workshop was purposed towards strengthening the scientific exchange and communication between the parties to promote collaboration and development of common protocols and analyses for testing sunflower response to drought stress at the genetic and epigenetic level. This collaborative effort has strengthened the interaction between researchers from the consortium labs, allowed for more interactive activities, deepened crop epigenetics insight, and promoted future synergies and collaboration between interested parties. In addition, participants discussed on the basis of their concerns with the speakers during the general discussions. The analysis of the workshops through a feedback survey gleaned several workshop insights and achievements.

2.1.2 Application of sensors and image analysis as tools for plant phenotyping

This workshop aimed to allow the acquisition of technological skills and expertise by the partners of CROPINNO in the topic of tools involving sensors and image analyses, but it was also open to the scientific community outside the project. With regard to this point, there were one attendee from UCM (Chile) and another one from UOC (Spain). The workshop program is given in **Annex 2**.

The workshop completely achieved the goal “Improving excellence capacity of the coordinating institution in the particular field of research as a result of the twinning exercise” (Expected impact 1 of the CROPINNO proposal). In particular, it is directly connected to the

main objective of CROPINNO project: “To step up and stimulate scientific excellence and innovation capacity of IFVCNS”.

Contributions by partner and invited speakers facilitated attendees to gain a broad overview of how to use sensors and image analyses as tools for plant phenotyping. Also, the visit to IAS-CSIC will surely improve the impact and efficiency of the participants’ research by learning how things can be done in different ways. Interactions between hosts and visitors had resulted in subsequent exchange of emails for discussing particular aspect of what was learnt during the workshop. Planned follow-up activities include visits of PhD students from/to Spain as well as preparations of future joint proposals, as considered in the Memorandum of Understanding that was recently signed between IFVCNS and IAS-CSIC. Lastly, the possibility of organizing a new workshop at IAS-CSIC in Cordoba in 2024 open to CROPINNO partners is being considered.

2.2 Training Schools

From M1 to M15 one training school was organized (**Table 2**), with combined participation of IFVCNS researchers and researchers from the host and other institution partners.

Table 2. Training School executed within the first reporting period of CROPINNO

Title	Duration	Location	Provider	No. particip. from IFVCNS	Date
Bioinformatics, SNP-based markers and application in breeding	5 days	UROS	UROS	19	03-07/07/23

2.2.1 Bioinformatics, SNP-based markers and application in breeding

The aims of the summer school were to deliver background information about the application of bioinformatics and SNP detection, as well as to establish contacts with various breeders and institutes by an excursion of several days. The event achieved the planned goals and expected outcomes. On the first day, there was an introduction to bioinformatics, RNAseq, databases, SNP-based markers, CLC genomic workbench and application in breeding. This was performed hands-on in a computer pool with access for each participant to a computer to directly apply different programs. The summer school program is given in **Annex 3**.

The further visits to the research institutes and private companies gave an insight into the pre-breeding program and research of the Julius-Kühn Institute and different sized breeding companies with the focus on various crop species. There was also an opportunity for networking to establish contacts between the breeders from IFVCNS and five different German breeding companies for possible future cooperation.

2.3 Short-Term Scientific Missions

From M1 to M15 three STSMs were executed (**Table 3**). During these STSMs an effective scheme for knowledge transfer via mobility of scientists was implemented.

Table 3. STSMs executed within the first reporting period of CROPINNO

Host	Visitor	Topic	Number of participants	Date
UROS	IFVCNS	Phenotyping for drought tolerance	1 researcher from IFVCNS	06-17/02/23

FZJ	IFVCNS	Quantification of phenotypic differences in root and shoot traits by use of high-throughput phenotyping platforms	2 researchers from IFVCNS	24/04-23/06/23
IFVCNS	UNIPD	Transcriptome analyses for identification of candidate genes for drought tolerance	2 researchers from UNIPD	15-19/05/23

2.3.1 Phenotyping for drought tolerance

One of the specific objectives of the CROPINNO project is to improve scientific excellence capacity at IFVCNS in the use of phenotyping and multi-omics in creation and development of climate-resilient crops through a different training programme. The main goal of the STSM "Phenotyping for drought tolerance" was to develop a protocol for *in vitro* screening of sunflower genotypes for drought tolerance using polyethylene glycol. All planned activities within STSM were realized. The protocol was successfully established, the trainee went through all stages of the protocol and is considered to be trained for the independent application of the protocol in future research aimed at creation of climate resilient crops.

This STSM achieved its planned goals and expected outcomes and all planned activities were carried out. A researcher from Biotechnology Laboratory of IFVCNS was successfully trained by UROS how to apply *in vitro* screening for drought tolerance testing. The researcher can transfer the gained knowledge to their colleagues and thus help IFVCNS to improve scientific excellence capacity in the use of phenotyping and multi-omics in creation and development of climate-resilient crops, which is one of the objectives of the CROPINNO project.

2.3.2 Quantification of phenotypic differences in root and shoot traits by use of high-throughput phenotyping platforms

The aim of this Short-Term Scientific Mission was the training of the participants from IFVCNS in state-of-the-art non-invasive phenotyping approaches developed at Forschungszentrum Jülich (FZJ). To achieve this aim, a sunflower root phenotyping experiment was performed using FZJ facilities. For this purpose, six IFVCNS sunflower genotypes (2 hybrids and 4 inbred lines) were phenotyped under drought stress.

The STSM was originally planned as a visit of one researcher from IFVCNS to FZJ for 3 months. This plan was adapted to one researcher who visited FZJ for 2 months and another researcher who visited FZJ for one month.

The STSM achieved its planned goals and expected outcomes. All planned activities within the STSM were carried out. The two researchers from IFVCNS were successfully trained by FZJ how to quantify phenotypic differences in root and shoot traits by use of high-throughput phenotyping platforms. Both researchers can transfer the gained knowledge to their Serbian home institute and implement the phenotyping routines at IFVCNS. This will help IFVCNS to improve scientific excellence capacity in the use of phenotyping and multi-omics in creation and development of climate-resilient crops which is one of the objectives of the CROPINNO project.

2.3.3 Transcriptome analyses for identification of candidate genes for drought tolerance

The aim of this STSM was to train IFVCNS staff in application of efficient protocols for RNA extraction, as well as gene expression analysis using RT PCR. To achieve this aim, a sunflower

drought stress experiment was performed *in vitro* and the obtained material was used for RNA extraction and RT PCR.

The STSM was originally planned as a visit of one researcher from UNIPD to IFVCNS for 2 weeks. This plan was adapted as to enable the visit of two UNIPD researchers for one week, thus enabling more efficient use of time allocated to the STSM.

The STSM achieved its planned goals and expected outcomes. All planned activities within the STSM were realized. IFVCNS staff was trained by visiting researcher from UNIPD in RNA extraction and application of RT PCR for gene expression analyses. The acquired knowledge and skills will help IFVCNS to improve scientific excellence capacity in the use of phenotyping and multi-omics in the creation and development of climate-resilient crops, which is one of the objectives of the CROPINNO project.

Upon returning to IFVCNS, trainees and participants to workshops, TS and STSMs shared their knowledge through reports and seminars. Visiting researchers are asked to provide a Seminar at the host partner. All the material, including presentations and protocols, is made available to all CROPINNO participants through a shared drive.




Annex 1

CROPINNO Workshop

Introduction to Epigenetics

23rd and 24th February 2023, Padua, Italy

UNIPD-DAFNAE CROPINNO Workshop Introduction to (Crop) Epigenetics		
		
<i>February 23rd and 24th Padua Italy</i>		
Agripolis Campus	Corte Benedettina	Aula Filanda
Thursday 23rd		
9:15 – 9:30	Welcome & opening	
9:30 – 10:45	An Introduction to Chromatin marks	Serena Varotto UNIPD
11:00 – 11:30	Coffee and sweets	
11:30 – 12:15	Epigenetic marks: DNA methylation	Cinzia Comino UNITO
12:30 – 13:15	Non-Coding RNAs	Emanuele De Paoli UNIUD
13:30 – 14:30	Lunch	
14:45 – 15:30	Collecting plant materials for Transcriptome studies	Justin Joseph UNIPD
15:45 – 16:30	How to sequence RNA	Stefania Vendramin BMR genomics
16:45 – 17:30	<i>General discussion</i>	
Friday 24th		
9:15 – 10:00	Chromatin dynamics and environment	Giorgio Perrella UNIMI
10:15 – 11:00	Chromatin in drought stress response	Serena Varotto UNIPD
11:15 - 11.45	Coffee and Sweets	
11:45 -12:30	Chromatin extraction in plants	Silvia Farinati UNIPD
12:30 – 13.30	Integration of chromatin data and transcriptomic data	Roberto Malinverni Sequentia Biotech Spain
13:30 – 14.00	<i>General discussion</i>	

Annex 2

CROPINNO Workshop

Sensors and image analyses as tools for plant phenotyping
25th and 26th October 2023, Córdoba, Spain

Wednesday 25th October	
Venue: Instituto de Estudios Sociales Avanzados Campo Santo de los Mártires, 7, 14004 Córdoba https://goo.gl/maps/xZlAr6gBFFWeLdWy7	
9.00 – 9.15	<i>Registration of participants</i>
9.15 – 9.30	<i>Workshop opening and welcome</i> Dr. D. Miladinovic (coordinator of CROPINNO) and Dr. L. Molinero-Ruiz (organizer of the Workshop)
9.30 – 10.15	<i>Proximal sensing of plant diseases</i> Dr. L. Molinero-Ruiz
10.15 – 11.00	<i>Remote Sensing for plant trait quantification: 25 years of progress using hyperspectral imagery</i> Prof. P. Zarco-Tejada
11.00 – 11.30	Coffee Break
11.30 – 12.15	<i>Use of thermal information to assess crop water status and irrigation requirements in orchards</i> Dr. V. González-Dugo
12.15 – 13.00	<i>Mapping soilborne plant pathogen incidence and long-distance dispersal risk in a changing climate with remote sensing and aerosol transport modeling</i> Dr. R. Calderón
13.00 – 14.30	Lunch
14.30 – 15.15	<i>High throughput phenotyping tools for breeding and agronomy research</i> Dr. J.A. Jiménez-Berni
15.15 – 16.00	<i>The use of high-throughput phenotyping for the genetic dissection of yield in wheat grown in Andalusia</i> Dr. P. Hernández
16.00 – 16.30	<i>Q&A, discussion, remarks</i>
Thursday 26th October	
Venue: Institute for Sustainable Agriculture Av. Menéndez Pidal S/N, Campus Alameda del Obispo, 14004 Córdoba https://goo.gl/maps/Tp99qtSR4z2kG7j19	
8.45	Bus shuttle to the Institute for Sustainable Agriculture. Departure from IESA
9.30 – 10.00	<i>Reception and practical issues</i> Dr. L. Molinero-Ruiz and Dr. L. Testi

10.00 – 10.30	<i>Visit 1</i> Lab Prof. P. Zarco-Tejada: <i>Laboratory for Research Methods in Quantitative Remote Sensing (Quantalab)</i>
10.30 – 11.00	<i>Visit 2</i> Lab Dr. J.A. Jiménez-Berni: <i>Laboratory of Phenomics and Digital Agronomy (AgroPhenoLab)</i>
11.00 – 11.30	Coffee Break
11.30 – 12.00	<i>Visit 3</i> Lab Dr. P. Hernández: <i>Seed and seedling phenotyping</i>
12.00 – 12.30	<i>Visit 4</i> Lab Dr. L. Testi: <i>Improvement of olive process-based modelling: visit to olive cultivar plot.</i>
12.30 – 13.00	<i>Visit 5</i> Lab Dr. L. Molinero-Ruiz: <i>Diseases of field crops. Visit to the greenhouse</i>
13.00 – 13.30	<i>General discussion and Workshop closing</i>
13.30	Bus shuttle to the city centre

Annex 3

CROPINNO Summer School

Bioinformatics, SNP-based markers and application in breeding
From 3rd to 7th July 2023, University of Rostock, Germany

Bioinformatics Day 03.07.2023	
Main Building Biological Sciences, Albert- Einstein-Str. 3, 18059 Rostock (MB) Computer Pool, Lecture Hall, SR 202 (CP)	
9.00 – 9.30	<i>Welcome, Introduction</i> Renate Horn
9.30 – 10.30	<i>Bioinformatics, NGS data, QTLseqR</i> Florian Schilling
10.30 – 11.30	<i>Novogene Webinar</i> Malin Alf
11.30-12.00	<i>Introduction to RNA sequencing</i> Malin Alf
12.00 –13.30	Lunch
13.30 – 13.50	<i>Databases and use</i> Robert Wagner
13.50-14.10	<i>HRM and KASP markers</i> Robert Wagner and Florian Schilling
14.10-16.00	<i>CLC Genomic Workbench</i> Florian Schilling
16.00	Discussion
Study Tour 04-07.07.2023	
04.07.	Tuesday
9.00 – 12.00	<i>Julius Kühn-Institut</i>
13.00 – 16.00	<i>Norika</i>
05.07.	Wednesday
9.00 – 12.00	<i>NPZ</i>
15.00-17.30	<i>SaKa</i>
06.07.	Thursday
13.30 – 16.30	<i>Benary</i>
07.07.	Friday
8.30-13.00	<i>KWS</i>
13.00	Depart to the airport