



WP4. Establishment of Diagnostic and Training Hubs (DTHs)

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Networking to Improve Diagnostic Efficiency

Healthy Plants = Healthy World



Description of WP 4

Diagnostic and training hubs (DTH) will be established at PIs in partner countries and equipped with additional equipment in order to serve as the future regional centers of excellence in the selected specific fields.



North Carolina State University
Plant Disease
 and
Insect Clinic

 UNIVERSITY OF MINNESOTA
 Driven to DiscoverSM



Plant Disease Clinic

**TEXAS
 PLANT DISEASE
 DIAGNOSTIC
 LABORATORY**

Department of Plant Pathology and Microbiology
 Texas A&M University
plantpathology.tamu.edu



plantclinic.tamu.edu

BACTERIAL STREPTOMYCE



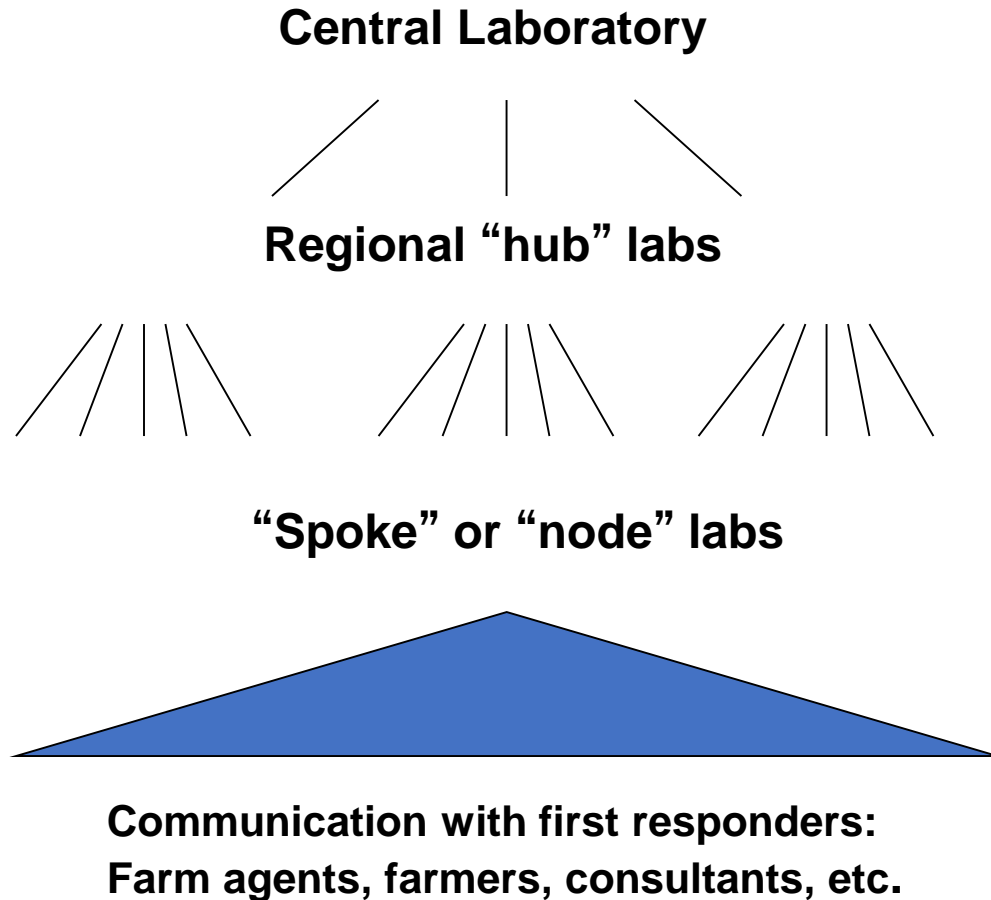
Healthy plants
 = healthy planet

PLANT CLINIC



 Jefferson County
 WASHINGTON STATE UNIVERSITY
 EXTENSION

Networking to Improve Diagnostic Efficiency (MODEL)



- Organized system of laboratories and personnel communicating with one another and working together
- Hierarchical structure
- Example: **U.S. National Plant Diagnostic Network**

The NPDN was established in 2002 in response to the need to enhance agricultural security through protecting health and productivity of plants in agricultural and natural ecosystems in the U.S. With support from the USDA-NIFA and through the collective efforts of many individuals representing Land Grant Universities, federal agencies, state departments of agriculture, and other stakeholders, the NPDN has grown into an internationally respected consortium of plant diagnostic laboratories. The specific purpose of the NPDN is to provide a cohesive, distributed system to quickly detect and identify pests and pathogens of concern. NPDN laboratories immediately report their findings to appropriate responders and decision makers. To accomplish this mission, the NPDN has invested in diagnostic laboratory infrastructure and training, developed an extensive network of first detectors through education and outreach, and enhanced communication among public agencies and stakeholders responsible for responding to

Diagnostic Laboratories by State:

Alabama (SPDN)

Alaska (WPDN)

American Samoa (WPDN)

Arizona (WPDN)

Arkansas (SPDN)

California (WPDN)

Colorado (GPDN)

Connecticut (NEPDN)

Connecticut AES(NEPDN)

Delaware (NEPDN)

Florida (SPDN)

Georgia (SPDN)

Guam (WPDN)

Hawaii (WPDN)

Idaho (WPDN)

Illinois (NCPDN)

Indiana (NCPDN)

Iowa (NCPDN)

Kansas (GPDN)

Kentucky (SPDN)

Louisiana (SPDN)

Maine (NEPDN)

Maryland (NEPDN)

Massachusetts (NEPDN)

Michigan (NCPDN)

Minnesota(NCPDN)

Mississippi (SPDN)

Missouri (NCPDN)

Montana (GPDN)

Nebraska (GPDN)

Nevada (WPDN)

New Hampshire (NEPDN)

New Mexico (WPDN)

New Jersey (NEPDN)

New York (NEPDN)

North Carolina (SPDN)

North Dakota (GPDN)

Oregon (WPDN)

Ohio (NCPDN)

Oklahoma (GPDN)

Pennsylvania (NEPDN)

Puerto Rico (SPDN)

Rhode Island (NEPDN)

South Carolina (SPDN)

South Dakota (GPDN)

Tennessee (SPDN)

Texas (GPDN)

Texas (SPDN)

Utah (WPDN)

Vermont (NEPDN)

Virgin Islands - US (SPDN)

Virginia (SPDN)

Washington (WPDN)

West Virginia (NEPDN)

Wisconsin (NCPDN)

Wyoming (GPDN)



Objectives

- To develop the **selection criteria** and identify the excellence of scientific groups within the PIs from partner countries
- To **upgrade existing facilities** in service of PhD students', staff and professionals' needs
- To establish **diagnostic and training hubs** with high expertise in particular fields available to serve as regional centers for education and spreading knowledge



Why to focus on plant disease diagnosis ?

- **Plant diagnostics** has been called **an art and a science**
- The art of diagnosis is a **system of rules** or **governing principles** and implies a trained ability or mastery of science
- A good diagnostician is a generalist with a **broad scientific knowledge** in subjects such as plant pathology, entomology, botany, plant physiology, plant anatomy, soil science, cropping systems, horticulture, greenhouse/nursery management, pesticides
- Successful diagnosticians are keen observers and good communicators.

<http://www.apsnet.org/publications/apsnetfeatures/pages/diagnostician.aspx>



Lettuce: *Sclerotinia*, *Pythium* or *Verticillium*



Almond orchard

*Phytophthora? Verticillium? Armillaria? Rosellinia?
Capnodis? Wood injury ? Water Logging ? ...*



Olive: Nutrient Deficiency or Toxicity from weedcides, insecticides, fungicides, fertilizers?



Olives : *Colletotrichum*, *Alternaria* *Fusarium* or soft nose



Grapevine: A particularly difficult case for diagnosis !!

Toxicity Diuron



Toxicity simazine and paraquat



Grapevine fanleaf virus



Viroid - grapevine yellow speckle



- Magnesium



Grapevine discoloration





WP4 Tasks



1. Selection criteria and evaluation procedure for diagnostic and training hubs - May 2019

Selection criteria: regional distribution, experience and scientific excellence in related area, human capacities, existing and requested equipment, and strategic action plan of the diagnostic and training hub.

A template for the equipment list and criteria will be developed

The call will be published on the web page.





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ANY EQUIPMENT
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THANK YOU

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Disease Diagnostic Capacity in every partner

Component
Standard laboratory workspace
Microscopes - Stereoscopes
Laboratory supplies and consumables (media etc)
Specialized workspace for molecular diagnostics/PCR
Specialized equipment for molecular diagnostics/PCR
Specialized equipment for serological diagnostics
Growth Chambers - Greenhouse
Reference materials
Internet access - Computers
Cameras



Selection Criteria for the purchase of equipment

1. Regional distribution
2. Experience and scientific excellence in related area
3. Human capacities
4. Existing and requested equipment
5. Strategic action plan of the diagnostic and training hub





EQUIPMENT

List of existing equipment for each partner

- Refrigerators
- Autoclaves
- PCR
- etc

List of equipment that need to be purchased (34,000 € / partner country)

- microscopes
- Centrifuges
- entomological cages
- etc..



2. Workshop: selection of candidates - October 2019

During the workshop planned in Belgrade (October 2019), WP4 members will **discuss the applications**, propose to **applicant improvements if needed** (regarding the type and performance of the proposed equipment) and select the best candidates.

The list of the approved DTHs and the list of the planned equipment will be sent to MB for approval. The approved list will be published.





Expected Deliverable/Results/Outcomes	Work Package and Outcome ref.nr	4.2.	
	Title	Workshop- selection of candidates	
	Type	<input type="checkbox"/> Teaching material <input type="checkbox"/> Learning material <input type="checkbox"/> Training material	<input checked="" type="checkbox"/> Event <input checked="" type="checkbox"/> Report <input type="checkbox"/> Service/Product
	Description	Applications will be collected. During the workshop planned in Belgrade (October 2019), WP members will evaluate the applications, propose improvements to applicant if needed (regarding the type and performance of the proposed equipment) and select the best candidates for each specific area. The list of the approved DTHs and the list of the planned equipment will be sent to MB for approval. The approved list will be published.	
	Due date	15.10.2019.	
	Languages	English	



Estimated Start Date	15.02.2019.	Estimated End Date	15.10.2020.
Lead Organisation	5. Agricultural University of Athens (AUA) 6. Agricultural University Tirana (AUT)		
Participating Organisation	1. University of Zagreb Faculty of Agriculture (FAZ) 2. University of Osijek (PFOS) 3. University of Aldo Moro Bari (UNIBA) 4. Agricultural University Plovdiv (AU) 7. University F.S. Noli Korce (UNKO) 8. University of Sarajevo (UNSA) 9. University of Mostar (SVEMO) 10. University of Belgrade (UB) 11. University of Novi Sad (UNS) 12. Biotechnical University of Montenegro (UOM)		

List of equipment of Plant Protection laboratories

1	Microscopes and stereoscopes
2	Autoclave
3	Precision balances / stirrers / hot plates / vortex / pH meter
4	Small laboratory equipment (glass pipettes, laboratory glass, ...)
5	Laminair air flow cabinet / Biosafety hood
6	4°C refrigerators, -20°C and -80°C freezers
7	Distiled / Double distilled water apparatus
8	Thermostatic incubator(s) /Orbital shaking incubator(s)
9	Centrifuges
10	Spectrophotometers
11	PCR thermal cyclers
12	Pipettes
13	Gel electrophoresis
14	UV spectrophotometer / Gel documentation system
15	Water bath
16	Fume hood
17	ELISA reader
18	Ice producing machine
19	Greenhouse / Plant and pathogen growth chambers with adjustable temperature-light-humidity
20	Different types of insect traps / cages

P6. Agricultural University Tirana (AUT)

List of existing equipment	
1	Analytical balance – Sartorius
2	pH meter – mettler toledo
3	Water bath Ultrasonic – VWR
4	Termobllok – VWR
5	Centrifuge – Eppendorf
6	Autoclave – vapormatic 770
7	Incubator - Memmert incubator
8	Strile cap – Vertical 700 laminar flow
9	ELISA READER
10	Liquid nitrogen container – GT 35
11	PCR BOX – VWR
12	Themocycle – Applied Biosystem
13	Gel electrophorese – SCE – Plast
14	Gel reader
15	Real Time LAMP – Enbiotech
16	Microscope – Optica
17	Vortex – VWR

	List of equipment that need to be purchased	Price
1	Real-time polymerase chain reaction (Real-Time PCR)	
2	Balance 0.01 g	
3	0.2ml PCR strip tube small centrifuge 5400rpm lab mini centrifuge	

Rationale ?

P7. University F.S. Noli Korce (UNKO)

	List of existing equipment
1	Microskope (4)
2	Stereo microscope
3	Autoclave
4	pH meters
5	Stereomicroscope with Digital
6	Microscopes (educational) (7)
7	Precision balances (2)
8	Stirrers
9	Distilled water equipment
10	Experimental fields, orchard (19 ha)
11	greenhouses
12	Water baths (2)
13	IT equipment (computer, scanners, printers) (3)
14	Small laboratory equipment (glass pipettes, laboratory glass, ...)

P7. University F.S. Noli Korce (UNKO)

	List of equipment that need to be purchased	Est Price (€)
1	Insect net cages and small incubators (for experimental vector studies, establishment of insect test colonies)	600
2	Analytical balance	2000
3	pH meter – mettler Toledo. CENTRIFUGE Scientific instrument that measures the activity of hydrogen ions by indicating its acidity or alkalinity	1500
4	Incubator - Memmert incubator. It is used to grow and maintain microbiological or cell cultures.	700
5	Liquid nitrogen container – GT 35. Container for storage and transport of biological materials	1200
6	Thermocycler – Applied Biosystems. Temperature control technology	10000
7	Gel electrophoresis – SCE – Plast For fast nucleic acid analysis with high resolution image capture accuracy	4500
8	Gel reader For the measurement of chemi-luminescence, fluorescence (green and red emission) and intensity	7000
9	Microscope – Optic To enlarge images of small objects.	2000
10	Vortex – VWR. Used to mix small volumes of liquid for cell disruption or homogenization.	350
11	Refrigerators, -20 & -80 freezer To keep petri plates with different pathogens	1200
12	Set of precision pipettes (necessary for training on DNA or RNA isolations, and all other steps in molecular procedures)	2000
	Total	33050

P7. University F. S. Noli Korce (UNKO) - Rationale

- At the Faculty of Agriculture, **University of Korce** currently **does not have a doctoral program in the field of plant health protection**. It is planned to be set up as a **joint program with the Agricultural University of Tirana**. So setting up a good laboratory in this field would be a great help in the realization of doctoral student study topics. It would be a very good help for the student of Bachelor and master too.
- The idea behind the list of equipment that need to be purchased during the HarISA project is to **modernise the PhD studies and to enable the development of two related areas – plant virology and entomology**.
 - **Net cages and small incubators** would be used **for breeding of insect colonies** in order to train students in conducting virus-vector experiments.
 - **Nanodrop**, the **orbital shaking incubator**, as well as the listed set of **pipettes** are essential in studies on viruses, especially for **PCR cloning techniques**. With the dawn of NGS, those techniques have become standard routine procedures and therefore need to be part of any PhD program in plant pathology.
 - The **fluorescence microscope (?)** would be used in different field, covering plant science, herbology, genetics and other.
- During the last years it became obvious that most students tend to be visual and physical learners. Hence we want to build a lab for ourself, to Learn, to Experiment, and to Explore.

P8. University of Sarajevo (UNSA)

List of existing equipment	
1	2 x PCR
2	Equipment for gel electrophoresis
3	Gel documentation equipment
4	Centrifuges
5	Vortex
6	Refrigerators, -20 & -80 freezer
7	Laminar flow cabinet
8	fume hood
9	Germinator
10	Growth chambers with adjustable temperature & humidity
11	Autoclave
12	Sterilization chamber
13	Lyophilizer
14	ELISA plate reader
15	Spectrophotometers

List of existing equipment	
16	pH meters
17	Stereomicroscope with digital camera
18	Microscopes (educational)
18	Precision balances
19	Stirrers
20	Distilled water equipment
21	Experimental fields, orchard and berry plantations
22	2 greenhouses
23	Apiary
24	Equipment for beekeeping
25	Vacuum packaging machine
26	Water bath
27	Liquid nitrogen container
28	ovens
29	IT equipment (computer, scanners, printers)
30	Small laboratory equipment (glass pipettes, laboratory glass, ...)

P8. University of Sarajevo (UNSA)

	Equipment	Estimated price (€)
1	Nanodrop (for the measurement of RNA or DNA concentration in samples)	9.796,53
2	Orbital incubator shaker (for cloning procedures, TA, plasmids)	4.643,55
3	Fluorescent microscope (for plant bacteria detection, as well as plant studies on GFP, chloroplast...)	5.100,00
4	Set of precision pipettes (necessary for training on DNA or RNA isolations, and all other steps in molecular procedures)	770,00
5	3D printer (for educational purposes and creation of 3D pathway models, as well as teaching material for plant studies)	7.567,12
6	3D scanner	2.000,00
7	Insect net cages and small incubators (for experimental vector studies, establishment of insect test colonies)	1.000,00
	TOTAL	30.877,20 *

*VAT excluded, exchange rate according to InforEuro (<https://ec.europa.eu/budget/graphs/inforeuro.html>)

P8. University of Sarajevo (UNSA) - Rationale

- The list of equipment that needs to be purchased is in accordance with the **Strategic plan set by the Institute of plant protection and food safety at the Faculty of Agriculture and Food Science**. The plan entails further **strengthening of the molecular research segment** as a significant backbone in the continuous development of the Institute.
- One of the biggest issues of the PhD program at the Faculty has been the **lack of equipment for molecular research activities** in the fields of plant pathology, entomology and related sciences. In this regard, **most PhD candidates had to search for other laboratories to conduct their research activities, which cost them money, effort and precious time**. Additionally, during their PhD studies **they are not trained to work in a laboratory**, therefore many of the students experience standard molecular procedures only when they start their own research. This again requires a lot of time in order for them to master those techniques. Additionally, it increases their fear of failure and can put a toll on their academic motivation and overall well-being. It is precisely for this reason that a lot of efforts have been invested in the establishment of a new laboratory that would enable student training in modern molecular techniques.

P8. University of Sarajevo (UNSA) - Rationale

- The idea behind the list of equipment that need to be purchased during the HarISA project is to **modernise the PhD studies and to enable the development of two related areas – plant virology and entomology.**
 - **Net cages and small incubators** would be used for **breeding of insect colonies** in order to train students in conducting **virus-vector experiments.**
 - **Nanodrop, the orbital shaking incubator,** as well as the listed set of **pipettes** are essential in **studies on viruses,** especially for **PCR cloning techniques.** With the dawn of NGS, those techniques have become standard routine procedure and therefore need to be part of any PhD program in plant pathology.
 - The **fluorescence microscope** would be used in different field, covering plant science, herbology, genetics and other.
- During the last years it became obvious that most students tend to be visual and physical learners. **The 3D printer would be used for modelling pathogen infections, pathways and other difficult systems** to help students in the learning process. Additionally, the 3D printer will be used for **manufacturing certain consumables by recycling plastic waste produced by the Faculty.** This will stress the importance of a **environment friendly mindset in students,** as well as **reduce the costs of their research.**

P9. University of Mostar (SVEMO)

List of existing equipment	
1	Spears flotation device (equipment for the extraction of cysts nematodes from soil samples).
2	Burkard Spore Trap
3	Atheling Soft Insect Surveyance System, field station
4	PinovaMeteo Station, field station
5	Stereo Microscope Optika SZM-LED2
6	Stereo Microscope Leica EZ4D
7	Microscope Motic BA 310 with Moticam 2500 5.0 M Pixel
8	Magnifier Lamp (model LU5200-00)
9	Ovens
10	Different types of insect traps
11	Laminar safe fast top 212 D

List of existing equipment	
12	Memmert Waterbath WNB 22
13	Incubator IPP 110
14	Incubator IPP 260
15	Vortex shaker ms3
16	Water bath
17	Centrifuges
18	pH meters
19	Plasma superartic 250 freezer
20	PS 1200.R2 Precision Balance
21	IT equipment (computer, scanners, printers)
22	Experimental fields

P9. University of Mostar (SVEMO)

	Equipment	Estimated price (€)
1	Fluorescent Microscope	25,705.00
2	Autoclave	6,315.00
3	Laboratory equipment (Micropipette)	780.00
4	Insect preparation sets (tools for mounting of specimens)	600.00
5	Insect collecting equipment (entomological nets, beating sheets, exhauster aspirators)	600.00
	Total	34000

P9. University of Mostar (SVEMO) - Rationale

- List of the equipment was created with **criteria of Faculties' need and future plans**. The aim is to **improve our curricula with special attention on entomology and mycology**. So we are aiming to use HarISA equipment budget in this direction. Our Faculty is **small with lack of space and equipment** in general so we are planning to **purchase equipment useful not only to plant protection department but to others as well**.
- There are several microscopes at the institution mostly used by students and professors in the classroom. They are not of the quality for serious scientific research. So we are planning **good fluorescence microscope** for teachers and students to use.
- **Autoclave** is needed for sterilisation of nutrient (growth) medium for organism's growth among other purposes like sterilisation of laboratory utensils and accessories. Autoclave is needed for any laboratory in plant protection and specially diagnosis.

P9. University of Mostar (SVEMO) - Rationale

- Huge part of our research in last few years is directed to **monitoring and determination of quarantine pests** as well as **economically important ones**. So it is our plan to keep building laboratory in this direction. Purchase of equipment needed for **collecting and breeding insects** to adult form (**sweep nets, beating sheets, aspirators, breeding cages**). In the light of pest determination there is also **equipment and supplies for microscopy and slide preparations** (tools for mounting of specimens).

P10. University of Belgrade (UB)

List of existing equipment	
1	1 greenhouse
2	3 plant growth chambers for performing pathogenicity assays
3	Experimental fields and vineyards
4	Pathogen growth chambers-incubator
5	SunScan Canopy Analysis Sistem
6	Incubator with temperature range 3-50oC, type FTC
7	Incubator with temperature range room temperature-50oC
8	Ultra-low temperature freezer (-80°C)
9	Orbital shaker
10	Light microscope
11	Autoclave
12	Laminar flow hood
13	3 Thermal cycler for PCR analysis
14	Real-time cycler for PCR analysis
15	Submarine electrophoresis units with power supply system

List of existing equipment	
16	UV transilluminator and gel documentation system
17	Pipettes set
18	4°C refrigerators
18	-20°C freezers
19	Water baths
20	2 technical balances
21	2 analytical balances
22	Magnetic stirrer
23	2 pH-meters
24	2 centrifuges
25	Mini shaker
26	Turbidimeter
27	ELISA reader
28	Microwave oven
29	Ice producing machine
30	UV transilluminator and gel documentation system

P10. University of Belgrade (UB)

List of existing equipment	
31	Stereo microscope
32	Field sprayers
33	Microchip Electrophoresis System for DNA/RNA Analysis MCE-202 MultiNA
34	PAM-2100 fluorometer
35	Minolta SPAD 502 chlorophyll meter
36	Loop magnification-Magnifier Circus
37	MagCore Nucleic Acid Extractor
38	TissueLyser
39	UVC/T-AR, DNA/RNA UV-cleaner box
40	Termomixer
41	Spektrofotometar UV-1800
42	Votrexes
43	Analytical balance

List of existing equipment	
44	Magnetic stirrer
45	Magnetic stirrer with hot plate
46	Water baths
47	Cryogenic Container
48	Shaker
49	Vacuum evaporator
50	Vacuum pumps
51	Ultrasound bath
52	Dry block
53	Laboratory dryers
54	Annealing oven
55	Liquid chromatograph with mass spectrometry
56	Gas chromatographs
57	1 phase-contrast light microscope Leica DMLS
58	Stereo microscope Leica MZ 12.5

P10. University of Belgrade (UB)

	Equipment	Estimated price (€)
1	LAMP apparatus	8.500
2	PCR UVP UV workstation	2.500
3	Laboratory pesticide spraying chamber (for precise application of pesticides in lab conditions)	7.000
4	Ice producing machine (necessary for training on biochemical, physiological and molecular procedures)	1.800
5	Photo Documentation Imaging System (necessary in molecular procedures)	2.200
6	Desktop Computers x 8 or 2 Stereo microscopes 2 Light microscopes Video beam projector	4.000 2.000 1.500 500
7	Camera for stereo microscope + Image analyzing software	3.000
8	Camera for light microscope + Image analyzing software	2.500
9	Digital drawing table A4	650
10	Refrigerator with deep freezer	350

P10. University of Belgrade (UB) - Rationale

- List of equipment intended to be acquired at Faculty of Agriculture University of Belgrade corresponds to mission and **goals of our institution**: implementation of high-quality academic study programs at all levels of study, development of relevant scientific research and implementation of the acquired knowledge and skills in the field of plant protection and plant health.
- **Proposed equipment will be used in all existing PhD study programs related to phytopathology, entomology and agricultural zoology, as well as pesticides and herbology.** In order to deliver high-quality academic programs and innovative science to the students new technologies and equipment present a essential element. Most of laboratories at Faculty of agriculture University of Belgrade are well equipped for specific fields of research such as detection and identification of plant pathogenic microorganisms and pests, detection of pesticides resistance in harmful organisms and pesticides residues in plants and plant products. However, **most of these laboratories lack certain pieces of equipment making it challenging to plan and carry out particular research programs. *Therefore, PhD students are forced to fulfill parts of their PhD thesis in some other national or more often international institutions. As a consequence, expenses of PhD studies are increased, along with prolonged duration of the PhD studies.*** Supplying these laboratories with the missing pieces of equipment would help to overcome this problem and enable them to become regional diagnostic hubs in the field of plant health and plant protection. It would also reinforce and advance the research capacity of these laboratories, enhance the expertise of the laboratory personnel and bring innovation in competitive research areas for existing young and experienced researchers.

P10. University of Belgrade (UB) - Rationale

LAMP apparatus, PCR UVP UV workstation

- Numerous molecular methods have been developed for the detection of plant pathogenic microorganisms, but none are truly applicable for on-site use in the field. Recently, a new molecular technology called **LAMP (loop-mediated isothermal amplification)** has been developed and revolutionized **clinical diagnostics and gained attention for improving plant pathogen detection and diagnostics**. LAMP has a number of essential advantages over PCR: it is portable, generally faster, more specific, simpler to learn and interpret, making it an ideal method to be used in PhD programs for rapid and on-site detection of plant pathogenic microorganisms. Among the diverse detection methods that are available today, LAMP can provide PhD students and researchers with reliable information on the infection status of their orchard and hence is a very promising new tool for sustainable crop protection. **PCR UVP UV workstation** is necessary in order to **expand the molecular studies in the field of phytopathology**. PhD students are constrained to make all master mixes in a laminar flow hood making it difficult to achieve their work assignment due to the overcrowded laminar hood and the cyclor during the week. Purchase of the PCR workstation would help to overcome this „bottleneck“ in the laboratory and ensure that research are conducted without interruption.

P10. University of Belgrade (UB) - Rationale

Laboratory pesticide spraying chamber, Ice producing machine, Photo Documentation Imaging System

- Laboratory for pesticide resistance and harmful organism's response to pesticides was established recently in order to investigate harmful organisms (weeds, insects, mites etc.) interactions with pesticides and their resistance to them. As resistance is a huge problem of modern agriculture many PhD students are interested to work on a PhD thesis in this topic. Through previous period sophisticated equipment for investigation of resistance on biochemical, physiological and molecular level was purchased, but equipment for some important steps of study is still missing. Namely, for all mentioned investigations first step is application of pesticides to target organisms, which should be very precise and adequately distributed in small laboratory amounts in order to obtain satisfactory and reliable results. For that purpose **Laboratory spraying chamber is necessary to achieve fully equipped laboratory which could be national and regional center for diagnosis of resistance to pesticides and training hub for enhancement of knowledge and competences in the field of pesticide resistance.** So far, for pesticide application a sprayer for chromatography was used, which does not ensure a uniform and precise distribution of the pesticide solution and depends on the skill of the worker to distribute the required amount of solution per unit area. Therefore, there is a risk of false positive results because of inadequate application of pesticides. Therefore, purchase of Spraying chamber will ensure that this problem is overcome. Also, **Ice producing machine** are necessary in this laboratory because many steps in biochemical and molecular methods have to be carried out at temperatures below 4 °C which should be achieved by keeping the samples in ice. **Photo Documentation Imaging System** is necessary for visualization of PCR products in molecular analysis of resistant harmful organisms with the aim to detect mutation responsible for resistance.

P10. University of Belgrade (UB) - Rationale

- **Computers** - Computers generally have become basic equipment for academic work. They last for several years and then have to be replaced by new ones. Projects like this one are usually providing some new computers.
- **Microscopes with image analyzing accessories** - At the Laboratory for entomology and agricultural zoology very small animals (insects, mites and nematodes) are studied. Use of both stereo microscopes (magnifications up to 100 ×) and light microscopes (magn. up to 1000 ×) is essential. Apart from bare observing these objects, measurements and illustrations (photographs and drawings) are required for identifications and descriptions. **Camera and additional device (monitor)** are needed for visualization of structural details and their measurements. Software package is needed to provide better conditions and more precise manner for morphometric analysis. A quality **A4 format digital drawing table** is necessary for producing line drawings of animals using digital technology for illustrations. Majority of PhD thesis at the Laboratory for entomology and agricultural zoology require numerous line drawings of animals. Traditional manual drawing technique, performed by a trained professional illustrator, is too laborious and time consuming, and is not available for PhD students.
- **Refrigerator with deep freezer** - This piece of equipment is necessary for PhD students to store their research samples. The samples of plant material and soil are voluminous and require adequate storing conditions. A deep freezer is needed for storing biological material for molecular expertise.

P11. University of Novi Sad (UNS)

List of existing equipment	
1	Conventional PCR Thermocycler
2	Equipment for gel electrophoresis
3	UV transilumiator
4	Gel documentation equipment
5	Thermomixer
6	Temperature-controlled incubator shaker
7	Centrifuges
8	Refridgerated benchtop centrifuge
9	Vortex mixer
10	Refrigerators, -20
11	Refrigerated cabinet
12	Refridgerated thermostat
13	Drying oven
14	Laminar flow cabinet
15	Fume hood

List of existing equipment	
16	Laboratory seed germinator
17	Growth chambers with adjustable temperature & humidity
18	Autoclave
18	Sterilization chamber
19	Lyophilizer
20	ELISA plate reader
21	Spectrophotometers
22	pH meters
23	Stereomicroscope with digital camera
24	Microscopes (educational)
25	Optical microscope with digital camera
26	Precision balances
27	Magnetic stirrers
28	Water distillation equipment
29	Experimental fields, orchard and berry plantations
30	Laboratory seed germinator

P11. University of Novi Sad (UNS)

	List of existing equipment
31	2 greenhouses
32	Apiary
33	Equipment for beekeeping
34	Vacuum packaging machine
35	Water bath
36	Liquid nitrogen container
37	Ovens
38	IT equipment (computer, scanners, printers)
39	Micropipettes
40	Densitometer
41	Small laboratory equipment (glass pipettes, laboratory glass, ...)

P11. University of Novi Sad (UNS)

	Equipment	Estimated price (€)	
1	Giga-8dd Basic 8 channel EPG recording system	4.940	6.440
2	Insect rearing chamber, Caron product	18.134,65	25.390
3	Insect rearing cages		

P11. University of Novi Sad (UNS) - Rationale

- **EPG (Electrical Penetration Graph) recording** system provides a live visualization and recording of plant penetration by insects with piercing mouthparts, such as homopterans and thrips. This can be of great interest to understanding of aphids and other sucking insects feeding behavior, especially for students that are in a process of education and gaining knowledge. This technique can be used in biological laboratories at Universities for studies on plant and insect physiology, insect-plant interactions, host plant resistance, pathogen transmission or insect (evolutionary) ecology. This shows insect activity live, not visible by other techniques.
- Together with previously described equipment, for laboratory experiments students need **rearing chambers to have insect colonies available for teaching process**. On the other side, rearing of insects, e. g. obstacles in colonies development in controlled conditions, food sources and similar, are of great help in practical work in entomological laboratories.

P12. University of Montenegro (UoM)

	List of existing equipment
1	experimental fields and vineyards
2	incubators
3	Laminar air flow cabinet
4	4°C refrigerators
5	water baths,
6	centrifuges
7	microscopes
8	ELISA plate reader
9	Spectrophotometers
10	Precision balances
11	Stirrers
12	Distilled water equipment
13	ovens
14	IT equipment (computer, scanners, printers)
15	Small laboratory equipment (glass pipettes, laboratory glass, ...)

P12. University of Montenegro (UoM)

	Equipment	Estimated price (€)
1	All items of equipment needed for next generation sequencing (NGS)	
2	Growth chamber with adjustable temperature-light-humidity for pathogenicity tests	
3	autoclave for sterilization of nutrient media	
4	Stereo microscope	
5	incubator	

P12. University of Montenegro (UoM) - Rationale

The list of equipment that needs to be purchased is in accordance with the plan for implementing PhD study program in area of plant health at Biotechnical Faculty of University of Montenegro (UoM). The plan foresees **establishing the molecular research segment as a significant unit in educational work in plant protection.** One of the biggest issues of the PhD program at the Faculty has been **the lack of equipment for molecular research activities in the fields of plant pathology, entomology and related sciences.** In this regard, future PhD candidates will have to search for other laboratories to conduct their research activities. Molecular tools needs to be more developed in the area of plant protection at the Faculty. **The lack of this equipment makes students not to be motivated to enroll PhD study program since their knowledge will not be adequately upgraded as it could be in other much better equipped institutions.** This is also the shortage in attraction of foreign students who could come to the Biotechnical Faculty for mobility. This is the strong reason why a lot of efforts should be invested in the establishment of a new laboratory that would enable student training in modern molecular techniques.

P12. University of Montenegro (UoM) - Rationale

The idea behind the list of equipment that needs to be purchased during the HarISA project is to modernise the PhD studies and to enable the **development of areas of plant pathology (with the focus on mycology and fungal resistance to fungicides) and entomology**. The list of needed equipment is made in accordance with priorities (priority number 1 is equipment for molecular research). **NGS techniques have become standard routine procedures and therefore need to be part of any PhD program in plant pathology**. Item number 2 **Growth chamber** – is needed to train students in conducting Koch postulates and pathogenicity tests as necessary step in diagnosis of plant pathogens and growth of plants in controlled conditions for many demonstration experiments. Item number 3 – **autoclave** is the third priority for routine work on sterilization of nutrient media and small laboratory utensils: the laboratory at this stage has only small bench autoclave with extremely small capacity. Item number 4 – **stereomicroscope** would be important for work in entomology for better observation and determination of insects. Item number 5 – **incubator** would be used for additional purposes since incubators that faculty possess are not enough.

3. Purchase of the equipment - September 2020

For each institution, the list of the equipment approved during the selection process will be prepared, the offers collected and the procurement process completed.

The procurement will be carried out according to the rules as proposed by EU commissions and local administration.

Partners shall organize the procurement in their institutions.



4. Forming a network of DTHs, signing agreements between DTHs - October 2020

The workshop in Tirana is planned in October 2020.

The network of DTHs will be arranged by defining the shared rules for getting the use of DTHs. Agreement containing the shared rules for getting the use of DTHs will be prepared, discussed and signed among PIs.





Thank you !!!!

