The International Laboratory for Plant Neurobiology was founded in 2005 thanks to the generous funding of Ente Cassa di Risparmio di Firenze. LINV is part of the University of Florence and located in the scientific campus of Sesto Fiorentino, Firenze. Thanks to the immediate proximity of LINV to other institutes of biology, chemistry and physics, there is excellent potential for scientific collaboration and the establishment of networks.

Under the leadership of Stefano Mancuso, young students, post graduate and post-docs study several aspects of behaviour covering electrophysiology, physiology and cell/molecular biology. LINV attracts researchers from all over the world, and it is associated with many institutes to exchange students, ideas and projects.

One of the main tasks of LINV is training young researchers in modern techniques of plant physiology, plant behaviour, molecular biology, stress physiology and many other research topics.

LINV @ Kitakyushu – The laboratory has an affiliated branch in Kitakyushu, Japan. Under the direction of Prof. Tomonori Kawano, young researchers work on the effect of light and oxidative stress in plants.

Director
Stefano Mancuso - University of Florence - stefano.mancuso@unifi.it

Scientific Advisory Board
Frantisek Baluska - IZMB - University of Bonn, Germany
Tomonori Kawano - LINV @ Kitakyushu – University of Kitakyushu Japan
Jinxing Lin - Chinese Academy of Sciences, Beijing, China
François Bouteau - Université Paris Diderot - France
Paco Calvo - University of Murcia - Spain
Plants can accurately compute their circumstances, use sophisticated cost benefit analysis, and take defined actions to mitigate and control diverse environmental insults.

They are capable of a refined self and non-self recognition, exhibit territorial behaviours and have complex communication skills. Communication and signalling in plants encompasses both chemical and physical communication pathways. Plants interact with animals. They attract them with colourful flowers or fleshy fruits to make sure their flowers get pollinated and their seeds dispersed. They offer sugary nectars to reward them for their protective services. Plants have a very rich social life, exhibiting different cooperative or antagonistic behaviours according to the degree of relatedness among them.

PLANT BEHAVIOUR
Scientific interest in plant movements, sensitivity, and possible intelligence has been continuously documented since the late 1800’s.

Studies on Plant Signalling covers diverse aspects of signalling and communication at all levels of plant organization, starting from single molecules and ending at ecological communities. Twentieth-century biology was dominated by attempts to reduce extremely complex biological phenomena to the actions of single molecules. While this process will continue in the future, we also need to integrate the avalanche of obtained data using system-based approaches. Plant Signalling will cover all plant sciences under one umbrella from the perspective of signalling and communication at all levels of biological organization by interlinking molecular biology with physiology and behaviour of individual organisms, up to the system analysis of whole plant societies and ecosystems. This integrative view will allow our understanding of communicative plants in their whole complexity.
Plants have a very well organized sensing system, which allows them to explore efficiently the environment and to react rapidly to potential dangerous circumstances. Below and above ground, plants are aware of the space surrounding them.

Such responsiveness is, indeed, necessary to provide the appropriate actions in response to the environmental stimuli. Plants have memory, are able to learn, to solve problems and to make decisions. We firmly think that all the behaviors observed in plants, which look very much like learning, memory, decision-making, and intelligence observed in animals, deserve to be called by those same terms. In short: 1) plants are intelligent 2) intelligence is a quality of life and 3) the brain is not the prerequisite for intelligence.
Plants are dynamic and highly sensitive organisms that actively and competitively forage for limited resources, both above and below ground; they accurately compute their circumstances, use sophisticated cost-benefit analysis, and take defined actions to mitigate and control diverse environmental insults. Plants are capable of a refined recognition of self and non-self and are territorial in behaviour. This new view sees plants as information-processing organisms with complex communication throughout the individual plant. Plants are as sophisticated in behaviour as animals but their potential has been masked because it operates on time scales many orders of magnitude less than that operating in animals.
LINV is equipped with advanced instrumentation for plant physiology, molecular biology, biomechanics, electrophysiology and microscopy imaging.

**Main Instruments:**

**MEA system** - monitors the spontaneous and evoked electrical activity of cells and tissues.

**VIP system** for the non-invasive and real-time measurement of net ion fluxes (or gas molecules) from plant cells and living tissues.

**PTR-MS-TOF** - the most sensitive and complete mass spectrometer on the market for the study of volatile compounds emitted in a complex system. It has a resolution of about 20 pptv and can identify the full spectrum of volatile with molecular weights ranging between 0 and 7000.

**Centrifuge for hyper-gravity experiments**

The centrifuge creates an acceleration of 1-5 g to perform experiments in hypergravity conditions for cells and small plants.

**Leaf gas exchange**

A portable gas exchange system (LI-6400XT) with the integrated fluorescence chamber head (LI-6400-40; Li-Cor Inc.) enables the simultaneous measurements of leaf gas exchange and chlorophyll fluorescence parameters.

**Microscopy imaging:**

- Leica confocal laser scanning microscope
- Zeiss fluorescence inverted Axio observer Z1
- Zeiss fluorescence Stereo Discovery V12

**3D printer and 3D scanner**

Keyence - 2D laser micrometre, a high precision, non-contact sensor for root morphology.

**Electrical Impedance Spectroscopy (EIS)**

A repeatable and non-destructive method to study the properties of cell membranes. EIS applications in plant tissues are numerous. It can be used to assess physiological stresses, freezing or heat injuries, dormancy induction, nutritional deficiency etc.
INTERNATIONAL LAB

PUBLICATIONS

YEARS

2005 2010 2015

PUBLICATIONS

0 50 100 150 200

Germany

Czech Rep.

Slovakia

Belarus

Israel

Australia

Poland

UK

USA

Chile

Spain

Other countries

France

2014 Progetto Medusa (Jellyfish Barge) Ente Cassa di Risparmio di Firenze e Regione Toscana.

2013 VOLATOM - Ente Cassa di Risparmio di Firenze.


2012 PRIN 2012 – Pro-ROOT

2012 PLEASED FET-OPEN FP7

2012 PLANTOID FET-OPEN FP7

2012 Marie Curie FP7-PEOPLE-2012-IEF

2012 ESA “Fly your thesis!”

2012 Bandito FIRB - Programma “Future in ricerca” The global virtual water network: social, economic, and environmental implications – ViWaN

2012 ARIADNA – ACT ESA Seed-driller

2012 A.R.I.A. Gli alberi come rilevatori dell’inquinamento ambientale - Regione Toscana

2011 ESA “Spin your thesis!”

2011 ESA “Drop your thesis!”

2010 Plant bioacoustics BOSE spa

2010 Flow and Gravity Ente Cassa di Risparmio di Firenze

2010 NEAR 52nd ESA-PFC

2010 ESA “Spin your thesis!” 2010

2010 ASI-BIONAS ISS through STS-134 mission

2009 51st ESA-PFC

2008 SOFIAU – Arsia Regione Toscana

2008 DLR Drop Tower Campaign

2008 ARIADNA – ACT ESA

“Bioinspiration by plants’ roots”

2008 49th ESA-PFC

2008 47th ESA-PFC

2007 46th ESA-PFC

2006 GOOD-FOOD FP6

2006 9th DLR-PFC

2006 43rd ESA-PFC

2005 PRIN – MIUR

2005 VQAPORM - 41st ESA-PFC

2004 LINV project Ente Cassa di Risparmio di Firenze

M Gagliano, M Renton, M Depczynski, S Mancuso (2014). Experience teaches plants to learn faster and forget slower in environments where it matters. Oecologia, 1-10


INTERNATIONAL LABORATORY
OF PLANT NEUROBIOLOGY