



CEPLAS

Cluster of Excellence on Plant Sciences



Why ISA? - A note on tabular metadata

May, 2021

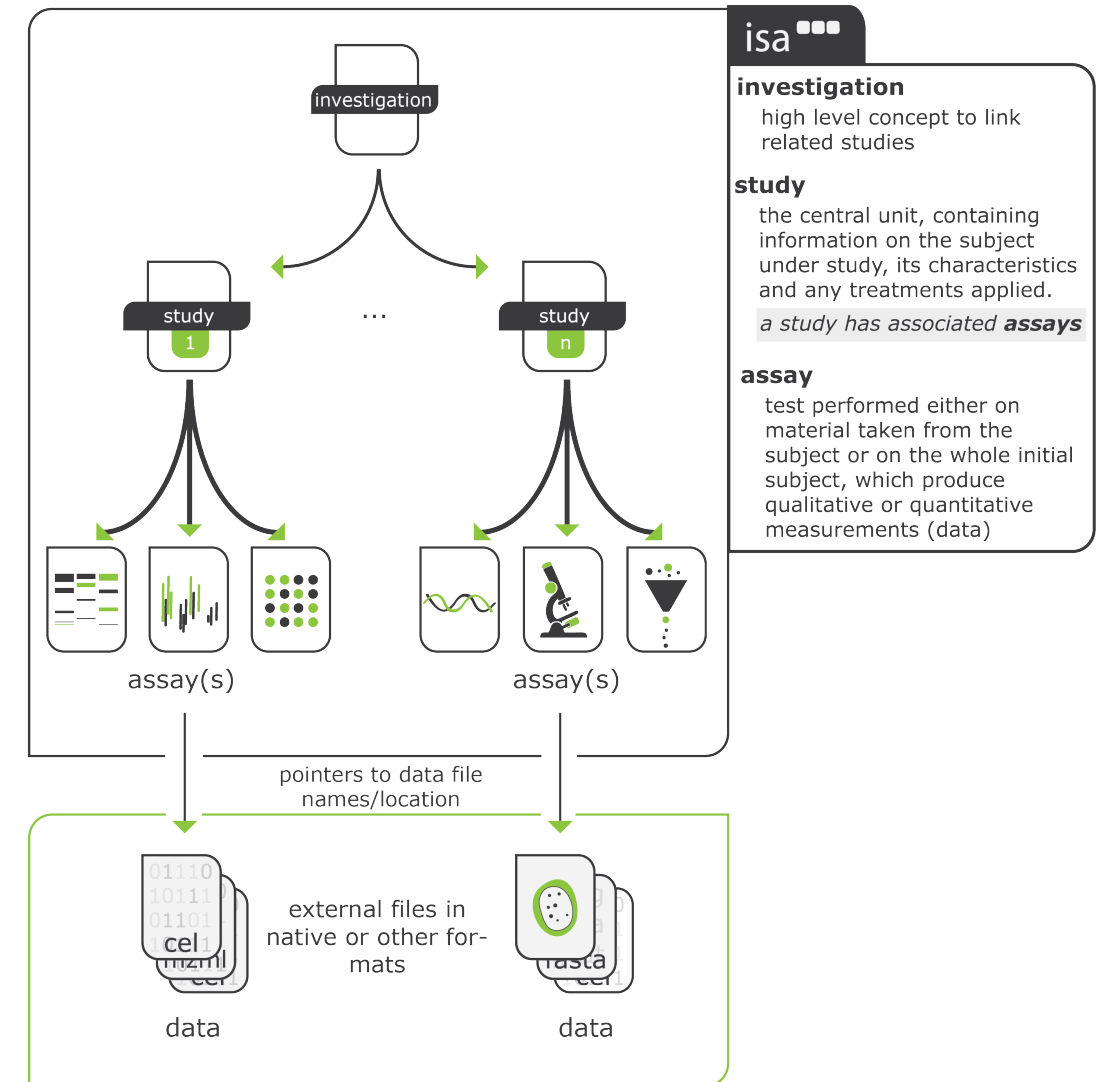
Hajira Jabeen & Dominik Brilhaus





The ISA Model of (experimental) metadata

- **Investigation**
 - Overall goals
 - Scientific context
- **Study**
 - Experimental steps
- **Assay**
 - Leading to (raw) data



<https://isa-tools.org/format/specification.html>



Plant Material and Growth Conditions

Talinum triangulare plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with 28-d-old plants in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was $425 \mu\text{mol m}^{-2} \text{s}^{-1}$. Irrigation was withheld on day 1 and recommenced on day 14. Leaves were harvested when plants were well-watered as well as after 4, 9, and 12 d of water deprivation and watered for two days following the drought period.

Brilhaus et al. (2016)
doi:10.1104/pp.15.01076



Plant Material and Growth Conditions

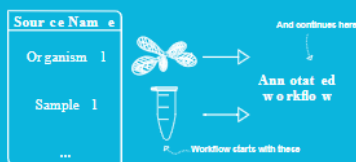
Talinum triangulare plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with 28-d-old plants in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was $425 \mu\text{mol m}^{-2} \text{s}^{-1}$. Irrigation was withheld on day 1 and recommenced on day 14. Leaves were harvested when plants were well-watered as well as after 4, 9, and 12 d of water deprivation and watered for two days following the drought period.

A	B	C	D	E
Sample Name	Sample description	Growth protocol	Experiment protocol	Sampling protocol
Panama_Tt001	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from well-watered plants
Panama_Tt002	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from well-watered plants
Panama_Tt003	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from well-watered plants
Panama_Tt004	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from plants after 4 days of water deprivation
Panama_Tt005	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from plants after 4 days of water deprivation
Panama_Tt006	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from plants after 4 days of water deprivation
Panama_Tt007	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from plants after 9 days of water deprivation
Panama_Tt008	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from plants after 9 days of water deprivation
Panama_Tt009	Leaves of 28-d-old <i>Talinum triangulare</i> plants	plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in “Short-One” treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was 425 mmol m ⁻² s ⁻¹ .	Irrigation was withheld on day 1 and recommenced on day 14.	Leaves were harvested from plants after 9 days of water deprivation

Source Name

The Source Name column defines the source of biological material used for your experiments. The name used must be a unique identifier. It can be an organism, a sample, or both.

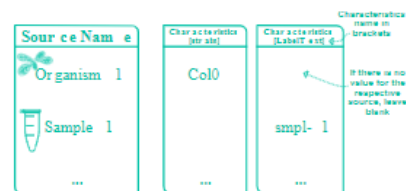
Every annotation table must start with the Source Name column



Characteristics

Use characteristics columns to annotate interesting properties of the source material.

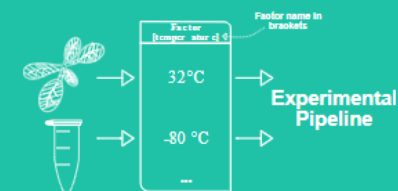
You can use any number of characteristics columns.



Factor

Use factor columns to track the experimental conditions that govern your study

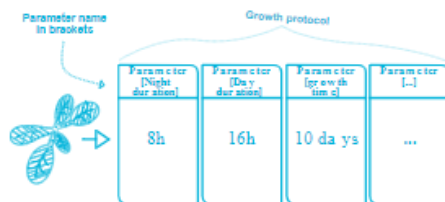
Most of the time, factors are the most important building blocks for downstream computational analysis.



Parameter

Use parameters to annotate your experimental workflow.

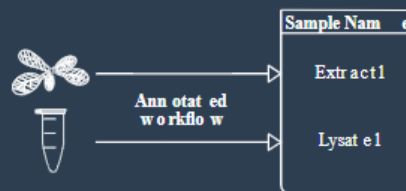
You can group parameters to create a protocol.



Sample name

The Sample Name column defines the resulting biological material of the annotated workflow. The name used must be a unique identifier.

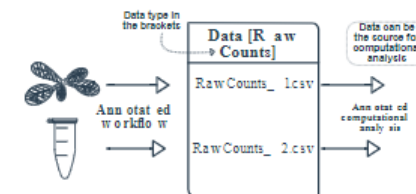
Samples can again be sources for further experimental workflows.



Data

The Data column describes data files that results from your experiments. Additionally to the type of data, the annotated files must have a unique name.

Data files can be sources for computational workflows.





Characteristics - e.g. plant source

Plant Material and Growth Conditions

Talinum triangulare plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in "Short-One" treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with 28-d-old plants in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was $425 \mu\text{mol m}^{-2} \text{s}^{-1}$. Irrigation was withheld on day 1 and recommenced on day 14. Leaves were harvested when plants were well-watered as well as after 4, 9, and 12 d of water deprivation and watered for two days following the drought period.

Brilhaus et al. (2016)
doi:10.1104/pp.15.01076

2	Source Name ▼	Sample Name ▼	Characteristics [Organism] ▼	Characteristics [Organism part] ▼	Characteristics [Plant age] ▼
3	Panama_Tt001	Panama_Tt001	Talinum triangulare	Leaf	28 days after germination
4	Panama_Tt002	Panama_Tt002	Talinum triangulare	Leaf	28 days after germination
5	Panama_Tt003	Panama_Tt003	Talinum triangulare	Leaf	28 days after germination
6	Panama_Tt004	Panama_Tt004	Talinum triangulare	Leaf	28 days after germination
7	Panama_Tt005	Panama_Tt005	Talinum triangulare	Leaf	28 days after germination
8	Panama_Tt006	Panama_Tt006	Talinum triangulare	Leaf	28 days after germination
9	Panama_Tt007	Panama_Tt007	Talinum triangulare	Leaf	28 days after germination
10	Panama_Tt008	Panama_Tt008	Talinum triangulare	Leaf	28 days after germination
11	Panama_Tt009	Panama_Tt009	Talinum triangulare	Leaf	28 days after germination
12	Panama_Tt010	Panama_Tt010	Talinum triangulare	Leaf	28 days after germination
13	Panama_Tt011	Panama_Tt011	Talinum triangulare	Leaf	28 days after germination
14	Panama_Tt012	Panama_Tt012	Talinum triangulare	Leaf	28 days after germination
15	Panama_Tt013	Panama_Tt013	Talinum triangulare	Leaf	28 days after germination
16	Panama_Tt014	Panama_Tt014	Talinum triangulare	Leaf	28 days after germination
17	Panama_Tt015	Panama_Tt015	Talinum triangulare	Leaf	28 days after germination
18					



Parameters - e.g. plant growth conditions

Plant Material and Growth Conditions

Talinum triangulare plants were grown in Miracle-Gro Potting Mix (Miracle-Gro) in "Short-One" treepots, 1.6 l (Stuewe and Sons). The experiment was initiated with 28-d-old plants in a controlled environment chamber (Environmental Growth Chambers) maintained under 12 h light (30°C, 37% relative humidity)/12 h dark (22°C) cycles. Photon flux density at leaf level was $425 \mu\text{mol m}^{-2} \text{s}^{-1}$. Irrigation was withheld on day 1 and recommenced on day 14. Leaves were harvested when plants were well-watered as well as after 4, 9, and 12 d of water deprivation and watered for two days following the drought period.

Brilhaus et al. (2016)
doi:10.1104/pp.15.01076

2	Source	Parameter [study type]	Parameter [growth chamber company]	Parameter [plant growth medium exposure]	Parameter [Flower pot]
3	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
4	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
5	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
6	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
7	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
8	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
9	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
10	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
11	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
12	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
13	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
14	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
15	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
16	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
17	Panama	growth chamber study	Environmental Growth Chambers, Ohio	Miracle-Gro Potting Mix	Stuewe and Sons "Short-One" treepots, 1.6 L
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Parameters - e.g. plant growth conditions

Plant Material and Growth Conditions

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Source Name	Parameter [Growth day length]	Parameter [Temperature Day]	Parameter [Temperature Night]	Parameter [Humidity Day]	Parameter [light intensity exposure]
Panama_Tt001	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt002	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt003	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt004	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt005	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt006	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt007	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt008	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt009	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt010	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt011	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt012	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt013	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt014	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second
Panama_Tt015	12 hr light / 12 hr dark	30.00 degree Celsius	22.00 degree Celsius	37.00 percent	425.00 microeinsteins per square meter per second



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Brilhaus et al. (2016)
doi:10.1104/pp.15.01076

Source Name	Factor [watering exposure]
Panama_Tt001	Well-watered
Panama_Tt002	Well-watered
Panama_Tt003	Well-watered
Panama_Tt004	4 days drought
Panama_Tt005	4 days drought
Panama_Tt006	4 days drought
Panama_Tt007	9 days drought
Panama_Tt008	9 days drought
Panama_Tt009	9 days drought
Panama_Tt010	12 days drought
Panama_Tt011	12 days drought
Panama_Tt012	12 days drought
Panama_Tt013	2 days re-watered
Panama_Tt014	2 days re-watered
Panama_Tt015	2 days re-watered



Brilhaus et al. (2016)
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Source Name
Panama_Tt001
Panama_Tt002
Panama_Tt003
Panama_Tt004
Panama_Tt005
Panama_Tt006
Panama_Tt007
Panama_Tt008
Panama_Tt009
Panama_Tt010
Panama_Tt011
Panama_Tt012
Panama_Tt013
Panama_Tt014
Panama_Tt015

Characteristics [Organism]	Characteristics [Organism part]
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf
Talinum triangulare	Leaf

Factor [watering exposure]
Well-watered
Well-watered
Well-watered
4 days drought
4 days drought
4 days drought
9 days drought
9 days drought
9 days drought
12 days drought
12 days drought
12 days drought
2 days re-watered
2 days re-watered
2 days re-watered



- CEPLAS
 - Homepage: <https://www.ceplas.eu/en/research/data-science-and-data-management/>
 - GitHub: <https://github.com/CEPLAS-FAIRidise>

- DataPLANT
 - Homepage: <https://nfdi4plants.de>

