

Experimental assessment of specific plant uptake factor of 1,2,4-triazole in wheat

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Introduction

Environmentally significant risk assessment decisions in EU for Plant Protection Products (PPP) regulation are based on information obtained from Environmental Fate models. Currently, guidelines detailing degradation and absorption processes of pesticides and their metabolites in soil do not accurately account for uptake by plants via root system, with plant uptake compartments only being given a default value. As plant uptake affects the environmental availability of these substances, accurately quantifying this contribution may result in more accurate prediction models. The purpose of the present study was to obtain reliable substance-specific plant uptake data using the study design proposed in draft working protocol (ECPA/IVA Working Group "Plant Uptake Factor", Frankfurt/Main, Germany, 26th May 2017).

Methodology

Material and test conditions

- Seeds: *Triticum aestivum* var. Fiorina.
- Test unit: 500 ml amber vessel, foam plug, (aeration equipment removable).
- Hydroponic solution buffered with MES 0,1% adjusted to pH 6.
- Test item: ¹⁴C/¹²C 1,2,4-triazole
- Test conditions: day/night cycle of 14/10h; 25 ± 5°C, 50 ± 25% humidity.
- PUF and the TSCF were calculated according to Eq.(1) and (2).

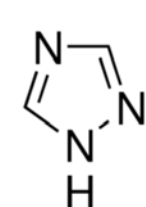
Eq. (1)

$$PUF = \frac{\ln\left(\frac{m_{sol-8}}{m_{sol-2}}\right)}{\ln\left(\frac{V_{sol-8}}{V_{sol-2}}\right)}$$

Eq. (2)

$$TSCF = \frac{\ln\left(1 - \frac{m_{shoots}}{m_{absorb} + m_{sol-8}}\right)}{\ln\left(\frac{V_{sol-8}}{V_{sol-0}}\right)}$$

- 1,2,4-triazole structure



Test:

- Treatment: 20 µg
- Replicates: 7 treatment + 3 evaporation control replicates (no plant-no test item) + 1 test item stability control (no plant-test item) + 8 plant control (biomass).
- Hydroponic solution volume: 350 ml
- Test phase duration: 8 days
- Intervals – 0 day (Application of test item); 2 days; 8 days.
- Air supplied saturated with water
- Measurements in hp solution: pH, O₂ (at all intervals).
- Weighing as in scheme.

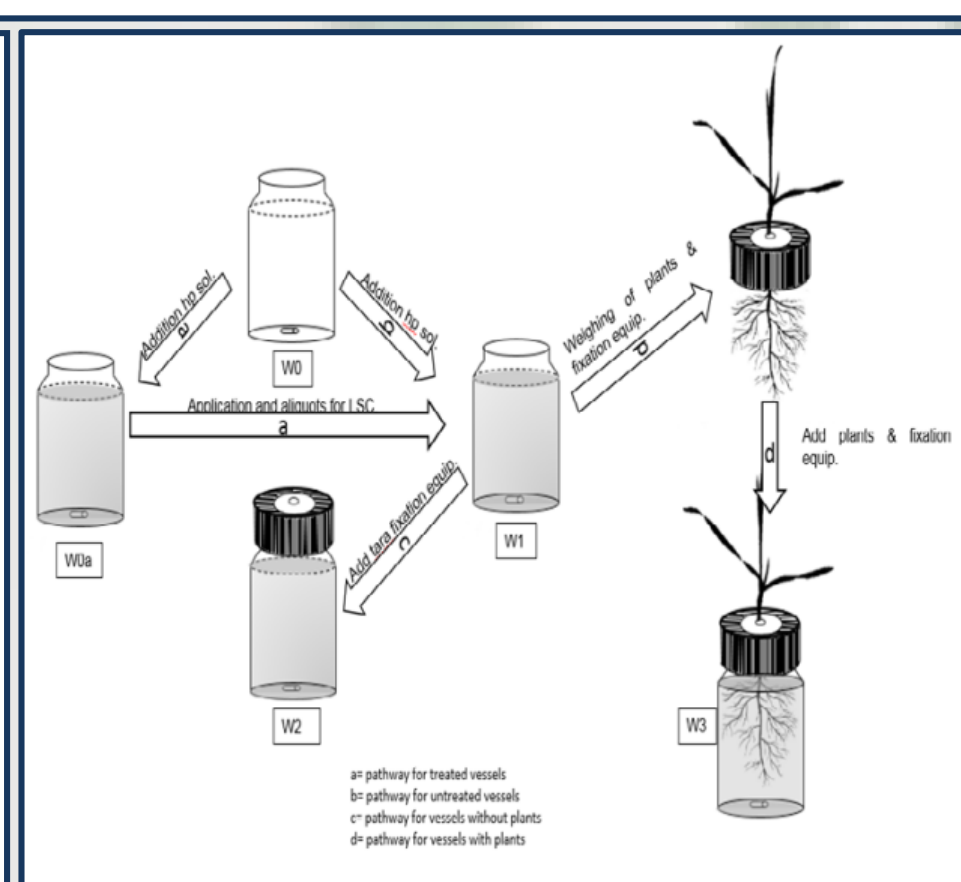
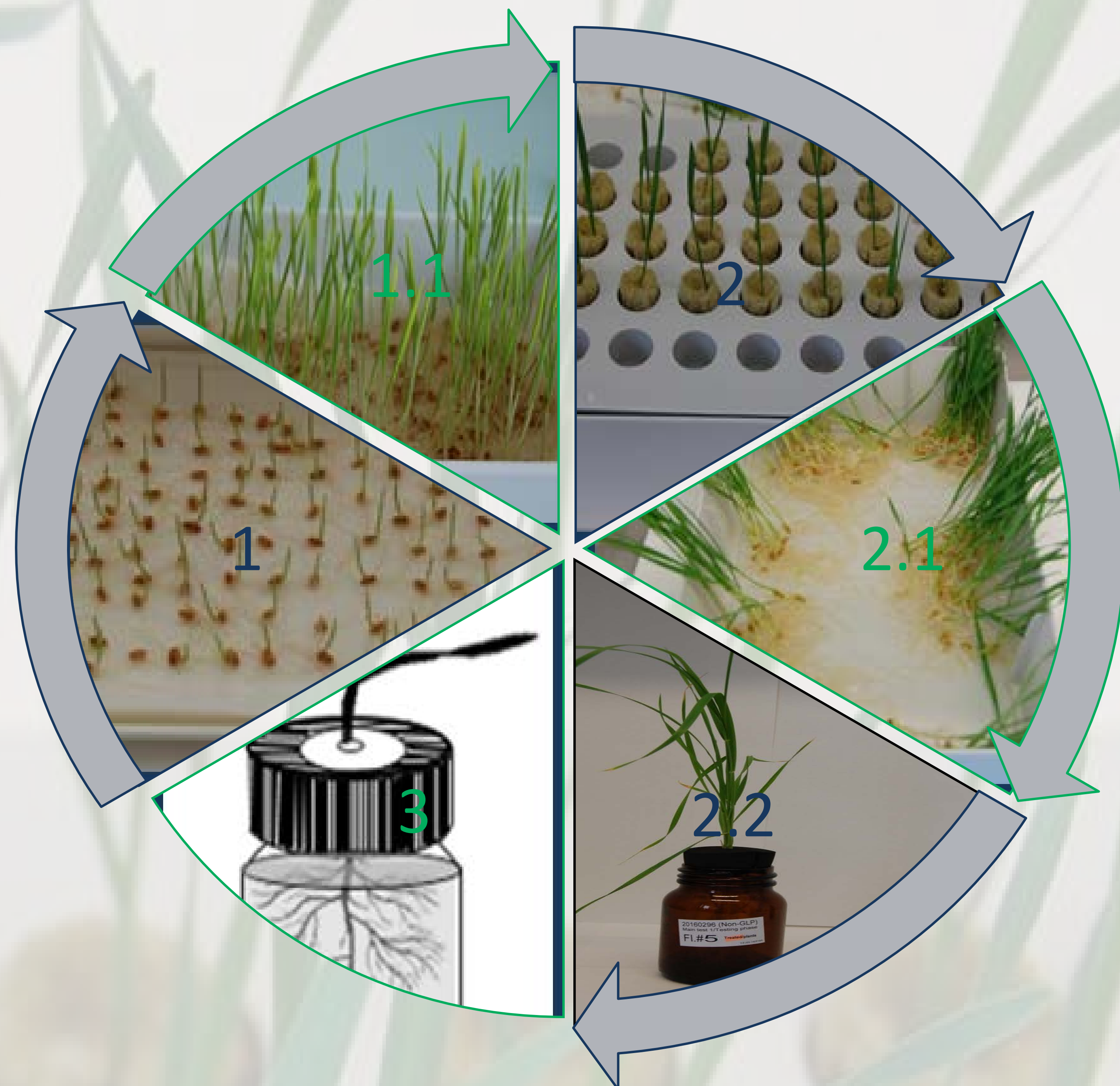


Fig.1. Weighing scheme during experiment



Study phases

- 1) Germination phase (4-7 days)
- 2) Growing phase: Selection of plants (2.1) for preconditioning (2.2) (about 7 to 10 days)
- 3) Test phase (8 days)

Results & Discussion

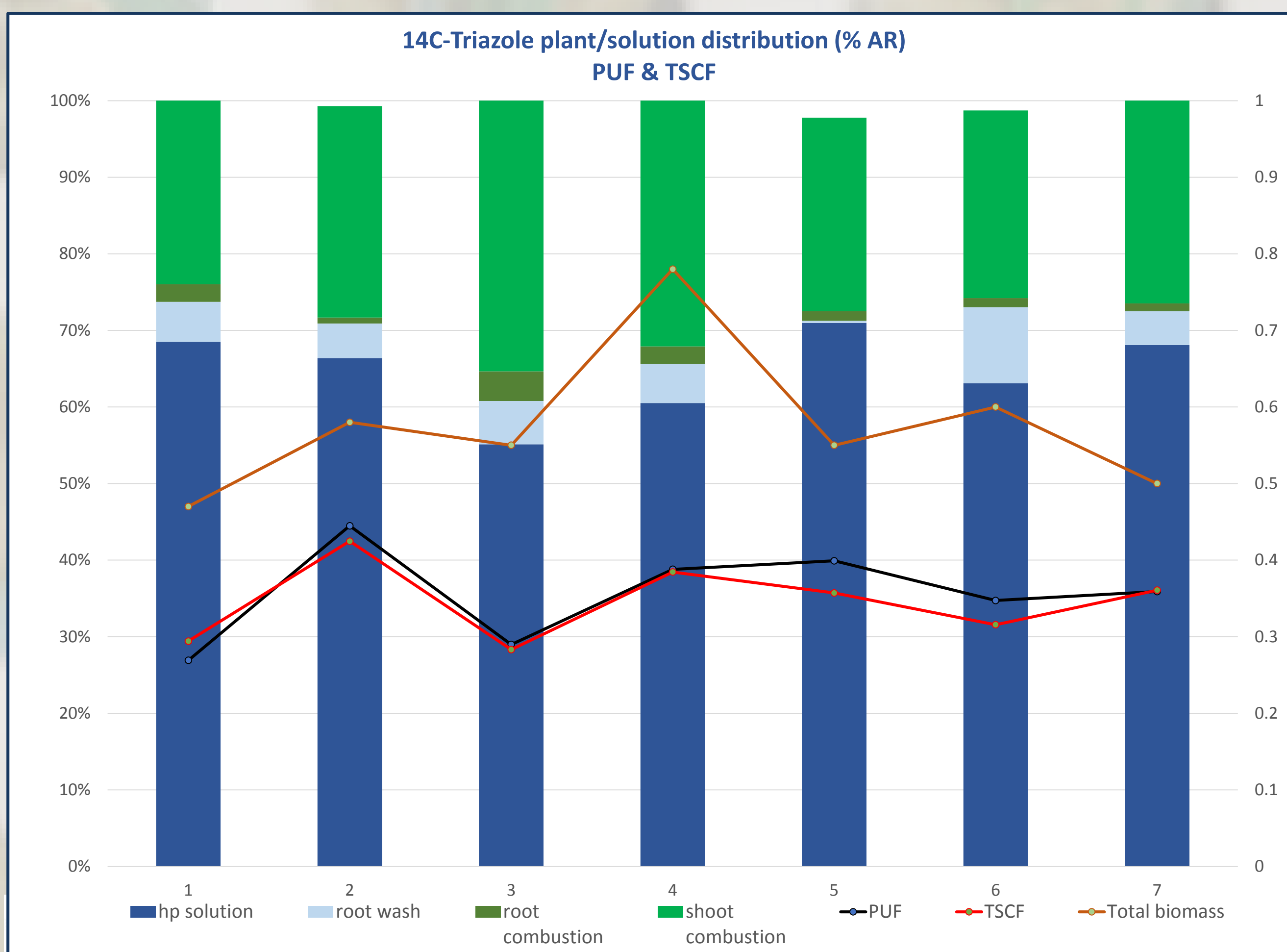


Fig.2. The bars represent the percentage of the total amount of ¹⁴C-Triazole applied and its distribution between root/shoot/solution (including washing of roots). PUF and TSCF (0 to 1) per replicate are also represented together with the total dry biomass (g)

Pretests

Toxicity test with ¹²C test item for a higher concentration than the target shown no visual effects. Tests with different set-ups lead to the actual system.

PUF & TSCF

The calculated mean values for these two factors is shown in the table below.

| | |
|-----------------|--------------|
| PUF mean value | 0,366 ±0,062 |
| TSCF mean value | 0,346 ±0,047 |

These values are low comparing with the ones reported by Lamshoef *et al* 2018 – 0,73 for PUF and 1.03 for TSCF.

pH & O₂

The pH of the solution within the replicates was between 6,001 and 6,526 along the experiment so the variation of pH from the beginning till the end of the experiment was about 0,5. The oxygen was kept above 35% , measured values were between 45,1 and 90,6 for all replicates.

Environmental conditions and water consumption

Average temperature during test phase was 30,5 ± 0,85 °C and relative humidity 29,7 ± 11,5%
 Light intensity was 217,7 W/m².
 Average water consumption along the replicates was 63,85 ± 0,09 % from initial volume (225,88 ± 30,75 ml)

Conclusions

- Need to standardize protocols
- Changes to consider for the test design:
- Increase number of replicates
- Need to introduce new measurements:
 - ➔ Solution's conductivity
 - ➔ Quantitative measurements for physiological plant status like SPAD index or related (to ensure homogeneity of plant health) in order to ensure repeatability.
 - ➔ Leaf surface area

Acknowledgment

We would like to thank our colleagues from IES for their help during the performance of this experiment.. This project would have been impossible without the support of the Department of Agricultural Chemistry and Food Science, Autonomous University of Madrid, thank you too.

Thanks to all friends and family who lead us till here, for their support and love.