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Department of Geography

Exploring the Potential of Plasma-treated Water to Improve Ecosystem Functions Derived by Soil Microorganisms

ESS 511 Master's Thesis

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Abstract

Arbuscular mycorrhizal fungi (AMF) are symbiotic soil fungi essential for enhancing plant nutrient absorption, increasing stress resilience, and promoting overall soil health. However, their use in sustainable agriculture is complicated by highly variable outcomes across different environments. Plasma-treated water (PTW), a novel technology enriched with reactive oxygen and nitrogen species (RONS), may influence plant–microbe interactions positively or negatively, depending on the application context. Its potential role in supporting AMF-based ecosystem functions remains largely unexplored. This thesis investigates whether PTW can enhance AMF functionality and how this interaction is modulated by plant species and soil type. Greenhouse and climate chamber experiments were conducted using Thai basil (*Ocimum basilicum* L.) and chives (*Allium schoenoprasum* L.) grown in four contrasting soils. Treatments included inoculation with *Rhizophagus irregularis*, irrigation with PTW, and their combination. Plant biomass was assessed through destructive harvest, and AMF root colonization was quantified using quantitative Polymerase Chain Reaction (qPCR).

The results revealed species-specific and soil-dependent treatment responses. Thai basil growth was primarily influenced by AMF and soil characteristics, while chives responded more strongly to PTW. In several cases, PTW and AMF showed synergistic effects—especially in chive biomass. PTW also influenced AMF gene copy numbers in a soil- and species-specific manner, although colonization levels did not always correlate with plant biomass. These findings highlight the complex interplay between plant, microbiota, and environment, underscoring the importance of tailored application strategies.

This study provides new insights into the compatibility of PTW with microbial inoculants and its potential to support AMF functionality in horticulture. It emphasizes the need for species- and soil-specific approaches and lays the groundwork for future research on plasma-based technologies in sustainable agriculture.

Table of content

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Full Term
AMF	Arbuscular Mycorrhizal Fungi
PTW	Plasma treated water
RONS	Reactive Oxygen and Nitrogen Species
qPCR	Quantitative Polymerase Chain Reaction
ANOVA	Analysis of Variance
DNA	Deoxyribonucleic Acid
PGPB	Plant Growth-Promoting Bacteria
pH	Potential of Hydrogen
P	Phosphorus
C	Carbon
N	Nitrogen
SDG	Sustainable Development Goal

1. Introduction

Given climate change, soil degradation, and escalating demands on food systems, the implementation of sustainable agricultural strategies is imperative. Central to these methodologies are microbial symbioses and innovative technologies that can improve plant performance under stress conditions (Bender et al., 2019; Ranieri et al., 2021).
For example, the United Nations’ 2030 Agenda for Sustainable Development highlights the importance of sustainable agriculture. The agenda underscores the need to transform our food systems as soon as possible (Bender et al., 2019; Ranieri et al., 2021).
Agriculture’s central role in combating hunger (SDG 2), promoting responsible consumption and production (SDG 12), as well as the mitigation of climate change (SDG 13) are being highlighted in this context, it is imperative that we find alternatives to conventional agriculture (United Nations General Assembly, 2015). The exploration of new approaches answers the global calls for more efficient, less chemically reliant cultivation (United Nations General Assembly, 2015).

1.1 Problems in conventional agriculture

Soil microbiota plays a crucial role in maintaining soil health and promoting sustainable agricultural production (Bender et al., 2019; van der Heijden et al., 2008). Soil ecosystems host an incredibly diverse network of life—bacteria, fungi, and other microorganisms—that work together to recycle nutrients, break down organic matter, and help protect plants from diseases (Garbeva, et al., 2004). Microbial communities are of great importance for soil fertility and healthy plant growth, as well as crop yield. However, intensive farming practises, such as the heavy use of chemical fertilisers and pesticides or even excessive tillage, can destroy this delicate balance (Kibblewhite et al., 2008). Intensive farming often relies on synthetic fertilisers to quickly boost crop production. Although these fertilisers provide nutrients in the short term, using them over long periods can gradually harm the health of the soil (Smith & Read, 2008). Heavy reliance on chemical inputs disrupts the natural balance of microbial life in the soil, leading to shifts in diversity and community makeup (Bender et al., 2019; Labouyrie et al., 2023). This imbalance can then undermine crucial soil processes—like nutrient cycling and organic matter breakdown—and ultimately weaken both soil structure and fertility (van der Heijden et al., 2008).
Another concern tied to frequent chemical fertiliser use is nutrient runoff, which can end up in nearby water systems and cause eutrophication (Köhler & Triebskorn, 2013). This process often triggers algal blooms that reduce dissolved oxygen and harm aquatic species. Moreover, repeated pesticide applications can negatively impact not only target

pests but also beneficial soil microorganisms that contribute to natural pest and disease suppression (Köhler & Triebskorn, 2013).

These challenges necessitate the adoption of more sustainable agricultural practises to preserve soil fertility and foster a robust microbial population. A promising strategy is the use of arbuscular mycorrhizal fungi (AMF) (Bender et al., 2019; Bender et al., 2023; Imperiali et al., 2017). AMF establish beneficial, symbiotic relationships with plant roots. They improve phosphorus (P) uptake and plant resilience to environmental stresses (Smith & Read, 2008). A stronger farming system that balances environmental health and productivity can be created by encouraging a healthy microbiota using AMF inoculation and other eco-friendly methods (Berruti et al., 2016; Romero et al., 2023).

1.2 Arbuscular Mycorrhizal Fungi Inoculation in Agriculture

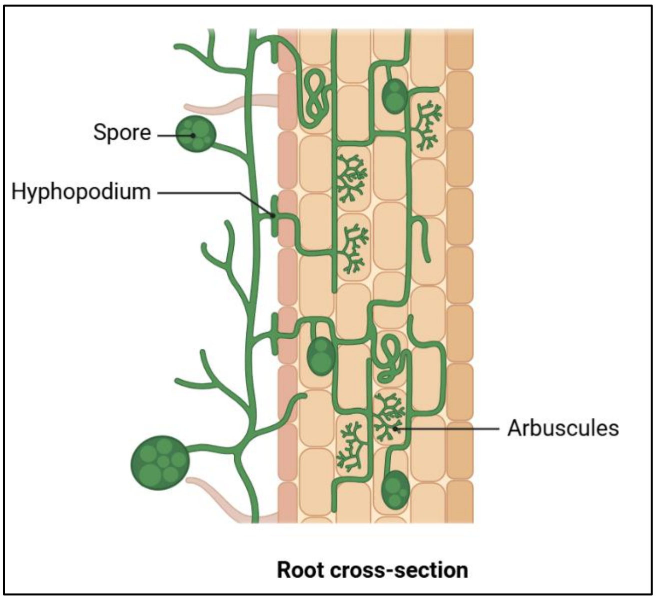

Figure 1: Schematic root cross-section showing colonization by arbuscular mycorrhizal fungi (AMF). AMF structures include external hyphae forming hyphopodia for root entry, intraradical hyphae branching inside root cortical cells, and the formation of arbuscules (site of nutrient exchange) as well as spores. This image illustrates the typical architecture of symbiotic colonization by AMF, such as Rhizophagus irregularis, within a plant root. Figure by author, created with BioRender

Arbuscular mycorrhizal fungi (AMF) are key contributors to terrestrial ecosystem functioning. Beyond enhancing plant nutrient uptake — especially P and nitrogen (N) — AMF improve plant resilience to abiotic stress such as drought, salinity, and heavy metals (Göhre & Paszkowski, 2006; Romero et al., 2023). Their networks of hyphae outside the roots help keep soil clumps stable, support a variety of microbes, and affect the movement of important elements like carbon (C) and N (Bender et al., 2019; Imperiali et al., 2017). Through these mechanisms, AMF serve as biological integrators that link plant performance, soil structure, and nutrient retention — making them critical agents for sustainable agriculture and ecosystem restoration (Bender et al., 2019; Bender et al., 2023; Imperiali et al., 2017). They are well known to form symbioses with most of the land plants (Bender et al., 2019; Roussis et al., 2022). In Figure 1 a root cross section of a plant that is in a symbiotic relationship with AMF can be seen in a schematic way.

The AMF belong to the *Glomeromycotan* phylum, and they get their name from their tree shaped structure called "arbuscule" (Roussis et al., 2022). They are obligated biotrophs and take carbon from the plant while providing water and nutrients, such as P, to the plant (Roussis et al., 2022). More than 80% of all land plants form symbiotic relationships with AMF (Lidoy et al., 2023; Renaut et al., 2020). Studies could show that they can influence plants positively in their health and growth (Bender et al., 2019; Imperiali et al., 2017; Ji et al., 2019). Their hyphal network helps them access large areas of soil (Bodenhausen et al., 2021; Corona Ramírez et al., 2023), which allows them to explore higher volumes of soil and therefore improve plant nutrient uptake (Bodenhausen et al., 2021; Roussis et al., 2022).

AMF enhance the plant content of nutrients, like P (Jansa et al., 2011; Smith & Read, 2008), while at the same time reducing the leaching of those nutrients (Bender et al., 2019). AMF can affect the stomatal conductance of plants (He et al., 2016), which can affect their resistance to drought.

Attempts have been made to inoculate AMF into crop fields to restore their functioning and increase crop growth (Lutz et al., 2023). However, in such field studies, the results of AMF inoculation were very variable. For example, a study by Lutz et al. (2023) found that the growth response of maize to the inoculation with AMF ranged from a 12% decline to a 40% increase in yield. The same study found that soil microbiota features explain a large portion of the observed differences in growth responses.

In addition, a significantly negative effect between establishment of the inoculated AMF and the abundance of the native mycorrhizal community has been shown, leading to the theory that the native microbiota can interfere with inoculation success (Bender et al., 2019). AMF interact with other plant growth promotion microorganisms (PGPM) in the soil. These interactions can be synergistic or competitive, depending on the combinations (Ashnaei, 2019). Studies showed that the order in which the AMF arrive compared to other AMF species, or more general in comparison to other PGPM, can influence the effectiveness of the AMF inoculation (Lutz et al., 2023; Verbruggen et al., 2013; Werner & Kiers, 2015). The species that arrives first has a significant advantage over the other species that come later. They can sometimes even physically block the newly arrived species from having access to the roots of the plants, as they stand in direct competition for the resources (Werner & Kiers, 2015).

1.3 Plasma-treated water

Plasma-treated water (PTW), a novel by-product of cold plasma discharge in liquids, has gained attention for its role in seed germination and pathogen control. Yet, its influence on beneficial soil microbiota — particularly AMF — remains largely unexplored.

Plasma, the fourth state of matter, makes up most of the universe (Ranieri et al., 2021). It is created due to electric stress in a gas medium. This electricity allows electrons that are naturally present in the medium to undergo processes with the molecules in the gas. "Those inelastic ionization or dissociation or excitation collisions due to the energetic electrons lead to the creation of new plasma species as radicals, ions, long-lived excited species, neutral by-products, photons and even electric field self-induced by the space

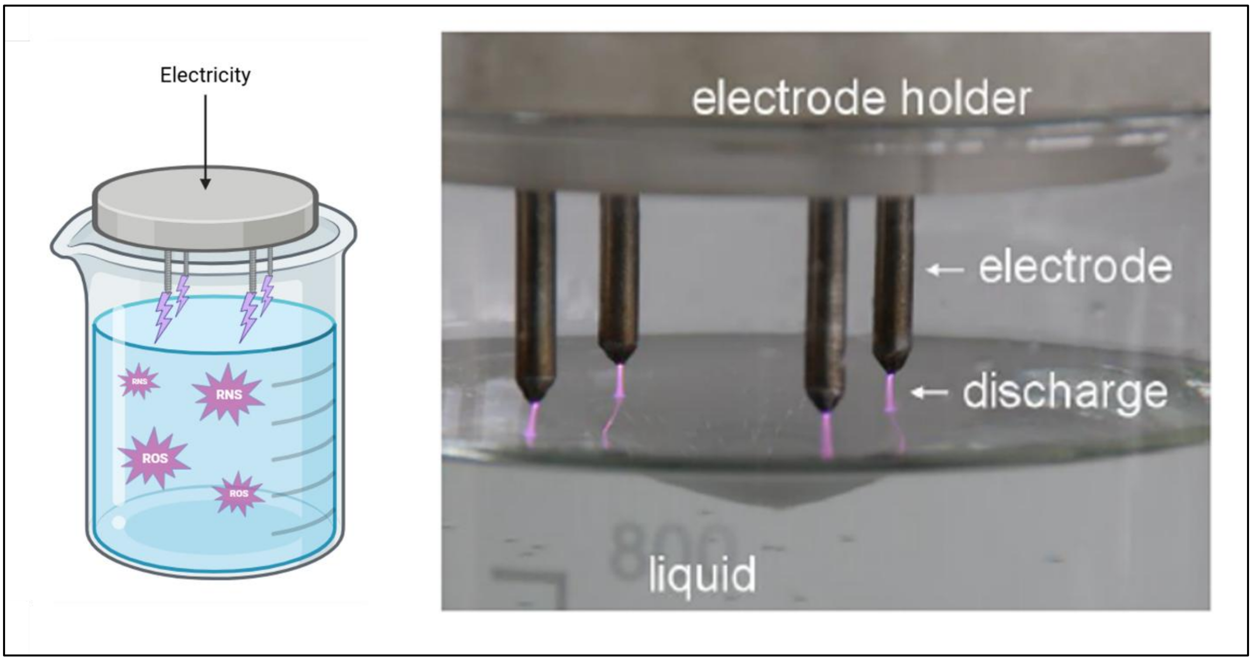

Figure 2: Production of plasma-treated water (PTW). The left schematic illustrates the generation of PTW via cold plasma discharge at the gas–liquid interface. Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are introduced into the liquid phase through electric discharge. The right photograph shows the wINPlas system in operation at the Leibniz Institute for Plasma Science and Technology (INP) in Greifswald, with visible micro-discharges forming between electrodes and the liquid surface. Figure created by the author using BioRender; photograph courtesy of INP Greifswald.

charges present in the plasma.", according to Bafoil et al. (2018). In plasma, the Reactive Oxygen and Nitrogen Species (RONS) are responsible for its bioreactivity (Figure 2).

While "plasma" refers to the ionized gas containing these reactive species, "PTW" is produced when those reactive species dissolve into water, thereby altering its chemical composition and imparting antimicrobial or growth-promoting properties (Liu et al., 2022).

The main RONS in PTW are H_2O_2, NO_2^-, and NO_3^-, with nitrogen being an important fertiliser for plants (Oh et al., 2018b). Due to the increase in nitrate and nitrite compared to untreated water, PTW seems to promote growth in plants (Thirumdas et al., 2018). The chemical reactions illustrating the interactions between atmospheric components in the plasma phase and water are complex and numerous. As this thesis does not focus on chemistry, a summary table is provided in Appendix H for reference. Up until now, plasma has mainly been used to decontaminate food, primarily during storage (Stoleru et al., 2020). Furthermore, it is used for wastewater treatment (Groele & Foster, 2019). To date, research investigating the effects of plasma or PTW on soil and soil microorganisms is scarce and contradictory results have been reported (Ranieri et al., 2021; Wang et al., 2020). PTW has been proposed to have positive effects on regenerating soil health and was shown to change the microbial community and enzymatic activity in the soil (Wang et al., 2020). Wang et al. (2020) observed a decrease in the following soil microbes: gram-negative and, anaerobe bacteria, eukaryotes, AMF, fungi, and actinomycetes. Experiments testing the effects of a plasma treatment on PGPM have shown positive outcomes. A plant growth-promoting bacterium became more active, grew better, and improved crop yield when treated with plasma, and it was also less likely to get fungal infections (Ji et al., 2019). These findings suggest PTW could serve as an alternative to chemical fertilisers.

In plants, treatment with PTW has been shown to accelerate germination and enhance growth responses (Stoleru et al., 2020). PTW was also shown to help wheat plants fight off pathogens. Furthermore, bacterial pathogens exhibited no signs of developing resistance to treatment with PTW (Los et al., 2020).

A study from 2020 done by Šimečková et al. examined how PTW influences the soil and its physicochemical properties. Their results showed slight changes in the water evaporation of the soil, as well as a slower water absorption if the amount of PTW was high. The pH of the soil stayed neutral, even though PTW is acidic (Siddique et al., 2021). Overall, they concluded that PTW can be used safely in agriculture without endangering the soil’s natural physicochemical properties (Šimečková et al., 2020).

Several studies have confirmed that PTW is both environmentally safe and non-toxic to humans (Guo et al., 2021; Nastasa et al., 2021). Unlike regular water, PTW has a higher redox potential due to the presence of RONS, which give it disinfectant properties without causing thermal damage to plants (Tan et al., 2024).

One of PTW 's main advantages over direct plasma exposure is its stability: while plasma decays rapidly, PTW maintains its bioreactivity for up to 15 days, making it more practical in agricultural applications (Siddique et al., 2021). This extended shelf life and safety profile position PTW as a promising alternative to conventional chemical treatments (Ostrikov et al., 2020). In terms of plant effects, PTW has been shown to enhance sprouting (Guragain et al., 2023), germination, and seedling growth (Guragain et al., 2021). It also supports plants under abiotic stress, such as drought (Bussmann et al., 2023), and strengthens their defence mechanisms, improving resilience against environmental challenges (Gierczik et al., 2020; Laurita et al., 2021).

1.4 Potential Positive Interactions Between AMF and PTW

To date, no study has systematically investigated whether PTW alters AMF functionality, colonization dynamics, or plant performance in ecologically relevant soil systems.

Both AMF and PTW have been found to help plants grow better and handle stress more effectively, though they do so through different methods (Bender et al., 2019; Ji et al., 2019; Ranieri et al., 2021). AMF mainly support plants by boosting their nutrient uptake, particularly P, and improving their resistance to environmental stressors. PTW, meanwhile, boosts plant growth and reduces diseases by introducing beneficial N compounds into the soil (Liu et al., 2022; Oh et al., 2018a). Because these two methods complement each other, combining AMF with PTW treatments could lead to even greater benefits than using either technique alone. First, the additional N compounds (such as nitrate and nitrite) in PTW can help support the P provided by AMF, leading to a better balance of nutrients for plants (Thirumdas et al., 2018). Secondly, PTW can inhibit or reduce soil pathogens (Wang et al., 2020), creating a more favourable environment for AMF colonisation and establishment. This is significant because competing or antagonistic microbes can compromise AMF activity (Ashnaei, 2019). Additionally, subtle concentrations of reactive species in PTW may serve as signalling molecules, triggering mild stress responses that strengthen plant defences (Gierczik et al., 2020; Laurita et al., 2021). This improved plant defence could indirectly boost AMF activity since healthier plants can more readily invest energy into forming beneficial partnerships when they are not continuously fighting off pathogens (Bender et al., 2023).

In other words, PTW might directly enhance soil quality and plant health, making it easier for plants to establish stronger and more productive relationships with AMF. At the same time, AMF can boost nutrient absorption and overall plant vitality, amplifying the positive effects of PTW. Further investigation into this combination could clarify whether applying PTW and AMF together provides greater improvements in plant growth, soil quality, and stress tolerance than either treatment alone.

1.5 Plant species

Thai basil (*Ocimum basilicum* L.) is an aromatic annual herb widely cultivated for its culinary uses and relatively short growth cycle. It has been shown to benefit notably from

AMF under stress conditions, improving both growth and stress tolerance (Hashem et al., 2016). By contrast, chives (*Allium schoenoprasum* L.) is a perennial member of the *Allium* family, characterised by fibrous roots and distinct nutrient requirements (Puligundla et al., 2018). These different growth features—especially how their roots are shaped and how they react to stress—make Thai basil and chives useful plants to study how plants react to adding of AMF and using different watering methods. Furthermore, their widespread use in smaller-scale horticultural systems highlights the practical importance of any observed benefits, such as enhanced nutrient uptake or resilience to environmental stress (Smith & Read, 2008).

1.6 Research Questions

By investigating these two species side by side, this thesis aims to determine whether positive treatment effects are consistent across diverse root structures and developmental patterns, shedding light on the broader applicability of innovative techniques like PTW and AMF inoculation.

The goal of this study is to see if PTW can affect the ecosystem functions provided by AMF, especially *Rhizophagus irregularis*, in two types of plants: Thai basil and chives. The research further examined how these effects vary across different soils.

This thesis, therefore, addresses the following questions:

1. **Does PTW influence the root colonisation of *Rhizophagus irregularis* in Thai basil and chives)?**

2. **Do PTW -induced changes in AMF colonisation affect plant biomass production?**

3. **How do plant species and soil modulate the interaction between PTW and AMF?**

It is hypothesised that PTW influences the abundance and composition of soil microbial communities, including AMF, due to the presence of RONS generated during PTW exposure. These reactive compounds may alter microbial viability, community balance, and root–microbe interactions. Specifically, PTW is expected to impact AMF colonisation in plant roots, either directly or indirectly through changes in microbial competition or plant root signalling.

Furthermore, PTW and AMF treatments are both expected to enhance plant growth, with PTW potentially increasing nutrient availability (e.g., N forms) and AMF improving nutrient uptake (especially P). A synergistic effect on plant biomass is anticipated when both treatments are combined. These effects are likely to vary depending on plant species and soil, as root traits, microbial communities, and soil properties interact to shape treatment outcomes.

These research questions are addressed using a combination of methods: biomass analysis to evaluate plant growth responses, qPCR to assess root colonisation by *Rhizophagus irregularis*, and microbial plating to explore potential changes in soil microbial communities. All analyses are based on data obtained from previously conducted experiments, as detailed in the Methods section.

2. Materials and methods

This chapter describes the experimental design, materials, and analytical methods used to investigate the interactions between PTW, AMF, and plant growth across different soils and species. The work includes preparatory experiments to optimise treatment conditions, followed by the main trial combining AMF and PTW treatments. Detailed descriptions of data collection, biomass analysis, molecular techniques, and microbial assessments are provided in the following sections.

2.1 Preparatory Work

During this master's thesis, data was collected from two sets of experiments: one greenhouse experiment at Agroscope (Zurich, Switzerland) and a climate chamber experiment at the Leibniz Institute for Plasma Science and Technology (INP) in Greifswald, Germany. The experiments focused on evaluating the effects of AMF inoculation and PTW on plant growth and AMF colonisation in Thai basil and chives.

2.1.1 Agroscope Pre-Experiment: AMF Soil Screening

The initial greenhouse trial aimed to assess the responsiveness of plants to AMF inoculation across eight field-collected soils (A–H) and determine their suitability for subsequent experiments. All soils were collected from arable fields near Agroscope Reckenholz at the end of February 2024, during fallow conditions. The soils varied in their composition and management history.

Table 1: soil texture and humus content of the eight experimental soils. Data on soil texture (sand, silt, and clay fractions) and humus content were obtained from colleagues at Agroscope, based on previous sampling of the experimental soils. Analyses were conducted according to the reference methods of the Swiss Federal Research Stations (Eidgenössische Forschungsanstalten FAL, RAC, FAW, 1996).

Soil	Sample ID	Sand (%)	Silt (%)	Clay (%)	Humus (%)
A	214	26	53	21	2.5
B	233	27	44	29	3.1
C	101	27	54	19	1.7
D	158	30	45	25	2.9
E	109	30	45	25	2.9
F	151	28	31	41	2.2
G	74	38	27	35	3.5
H	83	34	38	28	2.4

Data on Soil texture and humus content (Table 1) was obtained from colleagues at Agroscope who had previously sampled the soils used here. Soils were analysed according to the reference methods of the Swiss Federal Research Stations (Eidgenoessische Forschungsanstalten FAL, RAC, FAW, 1996).

After collection, they were sieved to remove stones and debris but were not sterilised, to preserve their native microbial communities. Samples were stored in cool, dry conditions until use.

In early March 2024, chives were selected as the model plant species, as previous trials had shown strong responsiveness to AMF inoculation. Each of the eight soils was either inoculated with *Rhizophagus irregularis* strain SAF22 (Schlaeppi et al., 2016) or received a control inoculum without mycorrhizal fungi, resulting in 16 treatments. Each treatment was replicated seven times across seven randomized blocks, yielding a total of 112 containers for chives. In addition, two blocks of Thai basil were planted using the same soil and inoculation treatments, adding 32 containers. In total, 144 cultivation containers were established. Seeds were obtained from a certified organic and biodynamic supplier (Sativa Rheinau AG, Rheinau, Switzerland). The seeds are Demeter-certified, ensuring compliance with high standards for ecological and biodynamic seed production.

Each 750 mL container was filled with 500 mL of soil and 5% of either live AMF inoculum or the sterilised control substrate. The AMF inoculum (*Rhizophagus irregularis* SAF22) was provided by Agroscope and is widely used in mycorrhizal research (Bender et al., 2019; Imperiali et al., 2017; Lutz et al., 2023). It was propagated in the greenhouse for 5 months using plantago (*Plantago lanceolata* L.) as host plant, following established protocols (Bender et al., 2019; Lutz et al., 2023). The resulting material contained a mixture of spores, hyphae, and colonised root fragments embedded in a sterile growth substrate. Control containers received an autoclaved version of the same substrate to maintain consistent nutrient and microbial backgrounds.

Experimental plants were cultivated in a greenhouse under a 16-hour light regime at 25 °C and watered with deionised water. Irrigation was adjusted to maintain 20% soil water content. Water content was monitored gravimetrically: a representative soil sample was dried for three days at 105 °C and reweighed to determine water loss. Cultivation containers were then weighed at planting, and individual watering regimes were calculated based on the difference between fresh and dry weights.

After five weeks of growth, plants were harvested. Shoots were cut at the soil surface, weighed fresh, and dried at 60 °C for two days to determine dry biomass. Roots were carefully cleaned, weighed, and frozen in 2 mL Eppendorf tubes for later analysis.

The results of this pre-experiment indicated that soils H and D produced significantly positive or near-significant biomass responses to AMF inoculation in both plant species, while soils C and G showed neutral or slightly negative responses. These consistent patterns across species informed the selection of these four soils for the main PTW experiment.

2.1.2 INP Pre-Experiments: Water Characterisation and Growth Conditions

To evaluate the feasibility of using PTW in climate chamber conditions, two pre-experiments were conducted at INP.

2.1.2.1 Preparation of PTW

PTW was produced using the wINPlas system, a non-thermal PTW generation setup developed at the Leibniz Institute for Plasma Science and Technology (INP). The system applies an electrical discharge to a gas–liquid interface, generating PTW directly at the water surface. This process enriches the water with RONS, such as hydrogen peroxide (H_2O_2), nitrite (NO_2^-), and nitrate (NO_3^-), which give PTW its characteristic redox activity and bioreactivity. The wINPlas system allows for reproducible production of PTW in larger volumes while maintaining stable physicochemical properties, making it suitable for experimental and agricultural applications (Ranieri et al., 2021). A mixture of deionised water and 25% tap water was used to ensure proper plasma discharge. Tap water was essential for generating reactive species in the PTW, as shown by Bafoil et al. (2018).

A basic water chemistry analysis was performed using Supelco test strips (Table 2). PTW showed increased concentrations of N species (NO_2^-, NO_3^-, O_2^{2-}) and a lower pH and conductivity compared to the control. Elevated nitrate and nitrite levels were expected to influence plant growth.

In addition to its biological properties, the energy input required to produce PTW was remarkably low. According to Dr. Nicola Wannicke (INP Greifswald, personal communication, 2025), the wINPlas system consumes approximately 0.0186 kWh during a 20-minute treatment cycle, translating to 0.54 Swiss Rappen at an average electricity price of 29 Rappen per kWh.

Table 2: Water analysis comparing control and plasma-treated water (PTW), measured on 02.06.2024. Values reflect changes in basic physicochemical properties following plasma treatment. Oxide concentrations were measured after 1:4 dilution of PTW. The treatment led to increased reactive N species and reduced pH, indicating the successful generation of a reactive water matrix.

	Control	PTW
Nitrite (No_2^2) [mg/L]	0	80
Nitrate (NO3-) [mg/L]	0	250
Oxide (O_2^2-) [mg/L]	0	2-5
pH	7.61	6.04
Conductivity [Ohm]	2420	1863

2.1.2.2 Growth Conditions

To identify appropriate growth conditions to ensure that the chives and the Thai basil would thrive, pre-experiments were conducted. Two trials were conducted to test plant compatibility with the climate chamber setup. The first trial used two soil types: one soil–sand mixture and one sterilised soil. Chives and Thai basil (48 containers per treatment) were watered either with control water or PTW. The second trial investigated irrigation methods using both Thai basil and chives, without AMF inoculation. Two watering strategies were compared: in the first, pots were watered individually from above using a measuring cylinder (top watering); in the second, pots were placed in trays and watered from below by adding water directly to the trays (bottom watering). Each method included 48 containers per plant species. Both treatment groups received either PTW or control water, allowing assessment of how watering method influenced the effect of PTW under climate chamber conditions.

These trials helped optimise chamber conditions and treatment application. Climate chambers were maintained at 23°C during the day, 17°C at night, with 12 hours of light and 75% relative humidity.

To prevent germination bias from PTW, all plants were watered with the control water mixture during the first week.

2.1.3 Main Experiment: Combined Effects of PTW and AMF

In the main trial, the four previously selected soils (C, D, G, and H) were used. Each soil received four treatment combinations: AMF ± and PTW ±. Both, chives and Thai basil, were grown with seven replicates per treatment, resulting in a total of 112 cultivation containers per species, and 224 containers overall.

Each Thai basil container held four individuals, while each chives container held twelve. To ensure uniform germination and density, seeds were deliberately over-sown, and seedlings were thinned to the required number once established. This approach allowed for consistent plant density and avoided replanting.

The containers were filled to the top with soil to ensure uniform light exposure across treatments, as differences in soil volume could affect canopy height and light intensity. Each container received either 5% AMF inoculum or a control inoculum, mixed homogeneously with the soil.

Plants were cultivated in climate chambers set to 23 °C during the day and 17 °C at night, with a 12-hour light period and 75% relative humidity. To simplify logistics, planting was performed temporarily staggered between 31.05.2024 and 06.07.2024. For the first week, all containers were watered with the control water mixture to avoid germination effects from PTW. After this, plants were watered every other day with either PTW or control water, depending on the treatment.

Watering was done from below: trays containing 28 cultivation containers were filled with 400 mL of water. The two PTW treatments were randomly mixed in the same trays, as were the two non-PTW treatments, and the trays were rotated regularly to ensure uniform exposure to environmental conditions.

Harvest occurred five weeks after planting. Shoots were photographed, counted for leaf pairs, and measured for length before being weighed fresh and again after drying at 60 °C for two days. Roots were cleaned, weighed, and frozen in 2 mL Eppendorf tubes for later qPCR analysis. Soil samples were collected and stored under cool conditions for microbial analysis.

In addition to crop biomass, weed shoots were also collected during the harvest. All visible weed biomass was separated from the main crop species, weighed fresh, and then dried at 60°C for two days before determining dry biomass. Weed biomass data were collected to assess potential treatment effects on non-target plant species.

A schematic overview of the experimental setup is provided in Figure 3.

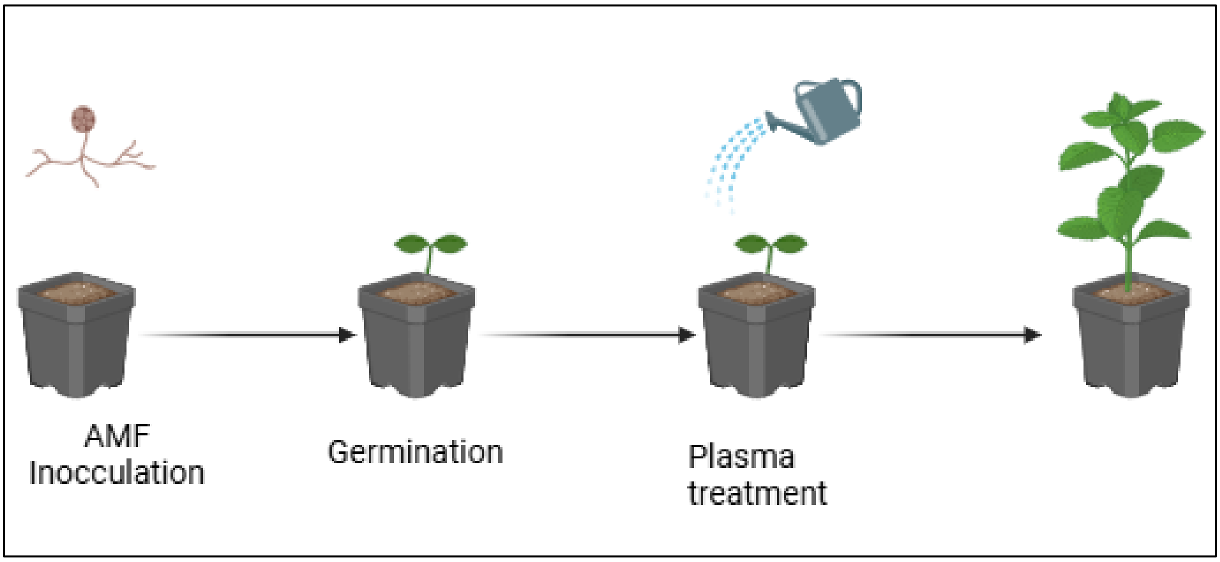

Figure 3: Simplified overview of the experimental setup. The schematic illustrates the general treatment sequence applied in the greenhouse and climate chamber experiments. AMF inoculation was conducted prior to seed germination, followed by growth under controlled conditions. After establishment, plasma-treated water (PTW) was applied, and plant development was monitored until harvest. Figure created by the author with BioRender.

2.2 Biomass Analysis

To analyse the effects on plant biomass, ANOVA analyses were conducted using the R programming language within the RStudio environment (version 2024.12.0+467; R Core Team, 2023). The following R packages were employed: "dplyr" (Wickham et al., 2023a), "ggplot2" (Wickham, 2016), and "readxl" (Wickham & Bryan, 2023b). This statistical approach allowed for a rigorous comparison of treatment groups, providing insights into how AMF and PTW affected aboveground and belowground biomass production. The model can be generally expressed as:

$$\text{Response} \sim \text{Soil} \times \text{AMF} \times \text{PTW}$$

Equation 1: Linear model structure used for ANOVA analysis. The response variable (e.g., fresh shoot biomass, AMF colonisation) was modelled as a function of soil, AMF inoculation (AMF), and plasma-treated water application (PTW), including all main effects and their interactions.

where Response refers to the measured variable (e.g., root fresh weight).

Data visualization techniques, such as boxplots and bar charts, were employed to illustrate treatment effects for each response variable, and custom colour palettes were used to distinguish between groups.

Table 3: Overview of response variables and corresponding fixed factors included in the biomass analysis. The Table summarizes which factors were considered in each model, along with the plant species included in the analysis. For weed biomass, data were collected separately for Thai basil and chive pots, but species identity was not explicitly assigned.

Response Variable	**Fixed Factors**	**Plant species**
Shoot biomass fresh	Soil, AMF, PTW	Thai basil, chives
Shoot biomass dry	Soil, AMF, PTW	Thai basil, chives
Root biomass fresh	Soil, AMF, PTW	Thai basil, chives
Weeds biomass fresh (shoot weight)	AMF, PTW	Undefined (Thai basil, chives pots separately)
Weeds biomass dry (shoot weight)	AMF, PTW	Undefined (Thai basil, chives pots separately)
Mycorrhizal growth response (MGR) fresh	Soil, AMF, PTW	Thai basil, chives
Mycorrhizal growth response (MGR) dry	Soil, AMF, PTW	Thai basil, chives
Root-to-Shoot ratio fresh	Soil, AMF, PTW	Thai basil, chives

In Table 3 the different analyses that were done on the biomass data are shown. As all analyses were done on both plant species, this led to a total of 14 different statistical models.

The root-shoot ratio was calculated using one of the following formulas (depending on whether fresh or dry mass was used):

$$\text{Root} - \text{Shoot Ratio} = \frac{\text{Root Fresh Weight}}{\text{Shoot Fresh Weight}} \text{ or } \frac{\text{Root Dry Weight}}{\text{Shoot Dry Weight}}$$

Equation 2: Root-to-shoot ratio formula used to assess biomass allocation. The ratio was calculated either using fresh weights or dry weights, depending on the analysis. It provides insight into plant resource allocation between below- and aboveground biomass, which can reflect stress adaptation, nutrient uptake efficiency, or treatment effects

Additional morphological parameters (e.g., number of leaf pairs, total shoot length) were recorded for each plant at final harvest.

The mycorrhizal growth response (MGR) analysis was conducted using the formula suggested by Köhl and van der Heijden (2016). MGR quantifies the relative change in plant growth due to AMF colonisation by comparing biomass in inoculated versus non-inoculated plants. A positive MGR value indicates that AMF had a beneficial effect on plant growth, while a negative value suggests a neutral or even detrimental response to the inoculation.

The formula used is as follows:

When D > C

$$\mathrm{MGR} = 100 \times \left(1 - \frac{\mathrm{C}}{\mathrm{D}}\right) = 100 \times \frac{\mathrm{D}-\mathrm{C}}{\mathrm{D}},$$

i.e., the percent increase in weight relative to the plant's own weight.
When D ≤ C

$$\mathrm{MGR} = 100 \times \left(-1 + \frac{\mathrm{D}}{\mathrm{C}}\right) = 100 \times \left(\frac{\mathrm{D}}{\mathrm{C}} - 1\right) = 100 \times \frac{\mathrm{D}-\mathrm{C}}{\mathrm{C}},$$

i.e., the percent change (usually negative) in weight relative to the control's weight.

$$\mathrm{MGR} = \begin{cases} \left(1 - \frac{\mathrm{C}}{\mathrm{D}}\right) \times 100, \text{if } \mathrm{D} > \mathrm{C}, \\ -1 + \frac{\mathrm{D}}{\mathrm{C}} \times 100, \text{if } \mathrm{D} \leq \mathrm{C}. \end{cases}$$

Where:
D=dry weight (the dry weight of the inoculated plant),
C=mean biomass (the mean dry weight of the corresponding uninoculated control plants.

Equation 3: Formula used to calculate mycorrhizal growth response (MGR), adapted from Köhl and van der Heijden (2016). MGR quantifies the relative growth effect of AMF colonisation by comparing the biomass of an inoculated plant (D) to the mean biomass of corresponding non-inoculated controls (C). Positive values indicate a beneficial effect of AMF on growth, while negative values suggest neutral or detrimental responses. Here, D = dry weight of the inoculated plant, and C = mean dry weight of the corresponding control group.

2.3 DNA Extraction and qPCR Analysis

For the investigation of AMF root colonisation, quantitative Polymerase Chain Reaction (qPCR) was used. This method was selected for its speed and reliability in quantifying the colonisation levels of *Rhizophagus irregularis* strain SAF22 (Agroscope, 2016) in root tissue. qPCR provides precise, reproducible results without the subjectivity associated with traditional line intersection methods (Bodenhausen et al., 2021; Corona Ramírez et al., 2023). Its objectivity and efficiency make it a powerful tool for understanding AMF–plant interactions in a sustainable agriculture context.

The frozen root probes that were attained during the preliminary experiments that preceded this thesis were analysed using a qPCR procedure. In a first step, the roots were lyophilised; for this, the freeze dryer Beta 1-8K (Christ, Osterode am Harz, Germany) was used. The Beta 1-8K freeze dryer was set up with a target value for freezing of −20 °C and a target value for the main drying of +15 °C and 0.630 mbar. After 24 h, the lyophilisation was finished. After this, the probes were ground using the FastPrep-24™ 5G bead beating grinder and lysis system (MP Biomedicals, Irvine, CA, USA), and the probes were weighed. DNA extraction was performed using the NucleoSpin 96 Plant II DNA kit (Macherey-Nagel, Düren, Germany). DNA concentrations were measured with the Cary Eclipse Fluorescence Spectrometer (Varian, Palo Alto, CA, USA), and results were double-checked using the NanoDrop One (Thermo Scientific, Waltham, MA, USA). Samples were then diluted to a concentration of 2 ng/µL for the qPCR analysis using the pipetmaX system (Gilson, Middleton, WI, USA). The qPCR analysis was done using 5x HOT FIREPol and EvaGreen qPCR Mix Plus (Solis BioDyne, Tartu, Estonia) with the F-primer (AMG1F: ATAGGGATAGTT-GGGGGCAT) and R-primer (AM1: GTTTCCCG-TAAGGCGCCGAA). Both primers are general mycorrhiza primers (Hewins et al., 2015). For all steps, the Vortex-Genie 2 (Merck, Darmstadt, Germany) was used. Centrifugation was performed using either the Sigma 4-16KS (Kuhner, Birsfelden, Switzerland) or the Biofuge Pico (Heraeus Instruments, Hanau, Germany). After the preparation the probes were analysed with the CFX Opus 384 Real-Time PCR System. The qPCR analysis was performed using the CFX Opus real-time PCR system, following a standard fluorescent dye-based protocol. Each run consisted of 39 cycles of precise heating and cooling steps designed to amplify the target DNA of *Rhizophagus irregularis* (strain SAF22).

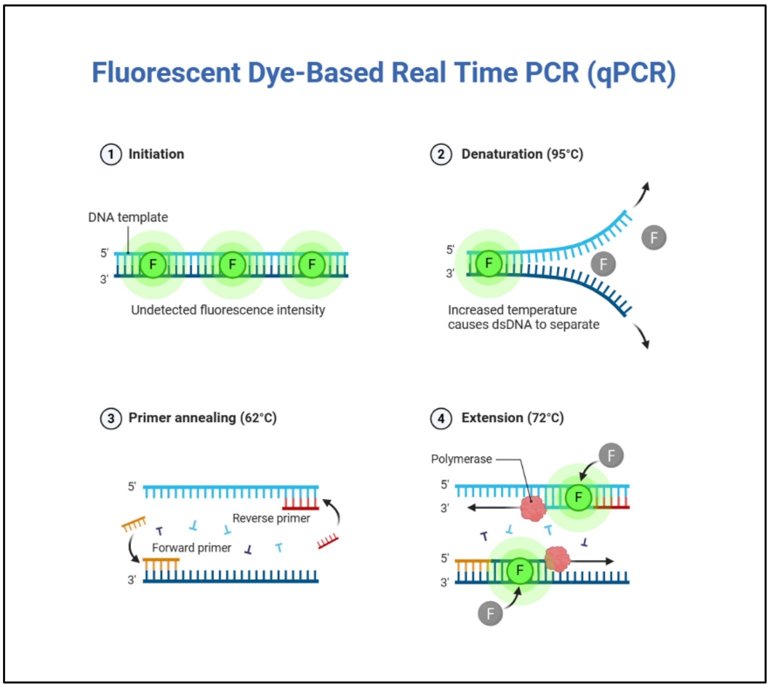

Figure 4: Fluorescent dye-based real-time PCR (qPCR) cycle. The illustration shows the four key steps of a real-time PCR amplification cycle using a fluorescent dye: (1) Initiation—baseline fluorescence is undetecTable before DNA amplification begins; (2) Denaturation—double-stranded DNA (dsDNA) separates at high temperature (~95 °C); (3) Primer annealing—specific primers bind to the target sequence at ~62 °C; and (4) Extension—DNA polymerase synthesizes a new strand at ~72 °C, with increasing fluorescence intensity as amplification progresses. Figure created by the author using BioRender. See Appendix for detailed qPCR protocol.

Figure 4 provides an overview of the four main steps of the qPCR cycle: (1) initial fluorescence baseline, (2) denaturation of double-stranded DNA at 95 °C, (3) primer annealing at 62 °C, and (4) extension at 72 °C, during which fluorescence signals increase as double-stranded DNA is synthesized and bound by fluorescent dyes. These dyes allow real-time tracking of DNA amplification across cycles, which is essential for quantifying AMF colonisation levels.

This schematic serves to illustrate the underlying principle of qPCR detection: amplification and fluorescence intensify in tandem, enabling accurate quantification of fungal DNA present in root samples. While this diagram does not represent specific experimental data, it visually supports the explanation of how colonisation by AMF was measured throughout this thesis.

The raw results were then analysed using the LinRegPCR Version 2014.2 (Ruijter, 2014): Analysis of Quantitative RT-PCR Data Program as a baseline, and further analysis was done in Excel. Absolute quantification of target DNA was derived from qPCR standard curves, and the final copy numbers were normalized to the sample mass. The copies per milligram of sample were estimated using Equation 4.

$$\text{Copies per mg} = \frac{\text{Average Cq} \times \text{Concentration} \times \text{Volume})}{\text{Sample Mass (mg)}}$$

Equation 4: Calculation of AMF gene copy number per milligram of root material. Here, “Average Cq” corresponds to the mean threshold cycle value, and “Concentration” refers to the amount of template DNA determined by the standard curve. “Volume” represents the elution volume of the DNA extract, and “Sample Mass” is the mass of root material used for extraction (in milligrams).

2.4 Microbiological analysis

To characterise the soil microbial community, microbial plating techniques were employed. These methods enable the isolation and quantification of microbial populations and provide insights into community composition and diversity. Although not the primary focus of this study, plating results were used to support exploratory analysis of treatment effects on the broader soil microbiota.

To get a better understanding of microbiological composition in the soils, a microbiological analysis with the plating on two different substrates of agar was carried out. The first substrate was a general agar medium, LB (Lysogeny Broth Agar [Lennox], Carl Roth GmbH + Co. KG, Karlsruhe, Germany). The second substrate, YMA (Yeast Mannitol Agar, NutriSelect® Plus, Merck KGaA, Darmstadt, Germany), was a medium that is often used for cultivating Rhizobia. The soil samples were weighed and filled in 1.5 µL Eppendorf tubes with 800 µL of autoclaved water, mixed for 15 minutes. Afterwards, they were centrifuged for 20 seconds at 100×g. Following the pipetting of the liquid phase, a dilution series was prepared. The undiluted, 1:100, and 1:1000 dilutions were plated on both

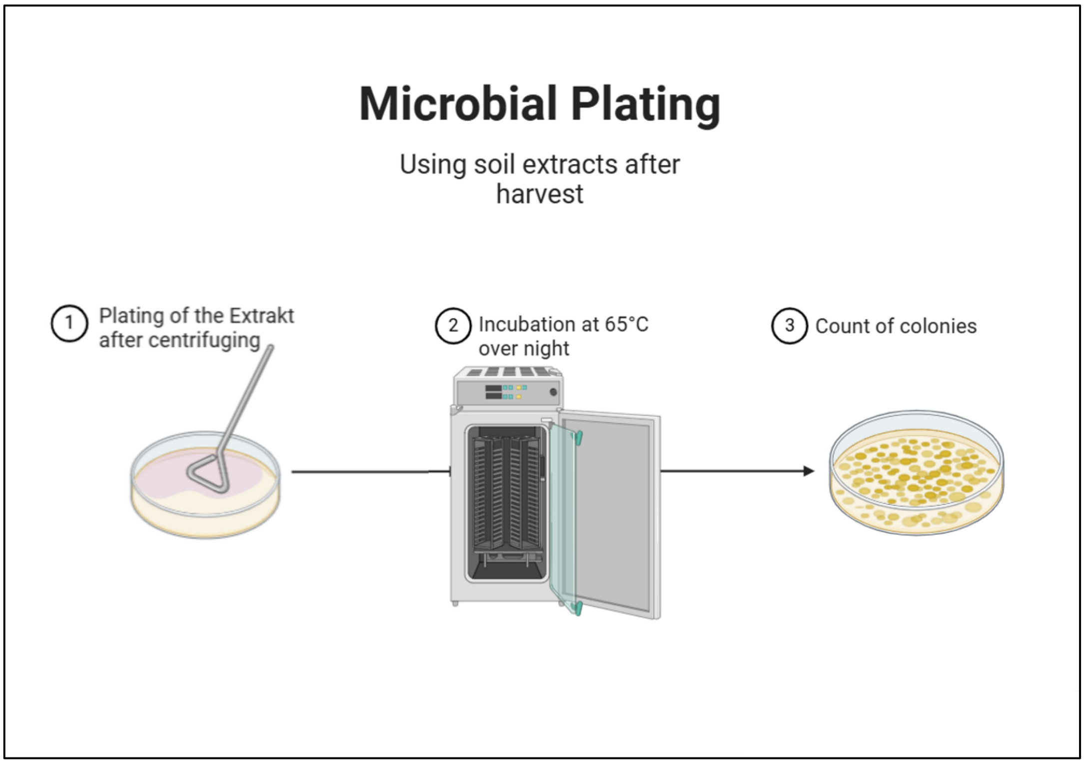

Figure 5: Microbial plating routine using soil extracts after harvest. The schematic outlines the microbial plating workflow: (1) Soil extracts were centrifuged, and the supernatant was plated on nutrient agar; (2) plates were incubated overnight at 65 °C; (3) resulting microbial colonies were counted to assess microbial abundance. This method provides a culture-based snapshot of microbial community responses to experimental treatments. Figure created by the author using BioRender.

substrates for the diluted samples in two volumes: 100 µL and 200 µL. This process resulted in a total of 20 plates. The plating was done over the span of three days, with incubation at 65 °C between colony counts (see Figure 5). This initial microbial plating was performed on the soils that were collected but not used in the greenhouse or climate chamber experiments. The purpose was to establish a baseline level of microbiological activity prior to treatment application. As this was a preliminary test to explore methodological feasibility, only one plate per dilution and substrate was prepared per soil, and no biological replicates were included.

A second microbial plating was conducted using soil samples collected after the final harvest. This analysis focused on two soils: Soil C and Soil G. From Soil C, all treatment groups (± AMF, ± PTW) were sampled. From Soil G, only the plasma-treated (+ PTW) and non-plasma-treated (− PTW) samples without AMF inoculation were included due to time constraints. Soil extracts were prepared following the same procedure as in the initial plating: weighed into 1.5 mL Eppendorf tubes, suspended in 800 µL of autoclaved water, vortexed for 15 minutes, and centrifuged for 20 seconds at 100×g. The liquid supernatant was used to create a dilution series (undiluted, 1:100, and 1:1000). From each dilution, 100 µL were plated on both LB and YMA substrates. All samples were plated in duplicate, resulting in six plates per treatment group.

Plates were incubated at 65 °C and colonies were counted daily for three days. Colony counts from each plate were averaged, and microbial abundance was expressed as the number of colony-forming units (CFU) per milligram of dry soil.

3. Results

In this section, the findings derived from the data collected during the research process are presented. In the following subsections the results from the biomass analysis as well as the results of the qPCR analysis are represented for Thai basil and chives respectively As a result, the main part of the Results chapter highlights the factors (biomass and qPCR) that produced clear and meaningful results, giving a better understanding of how PTW, AMF, and soils affected Thai basil and chives in the tests conducted.

3.1 Preparatory results: Soil-Specific Biomass Responses to AMF

An initial assessment of AMF inoculation effects was conducted using Thai basil and chives grown in eight different soils. The results revealed distinct variation in plant biomass responses to AMF treatment across soils (Figures 6 and 7).

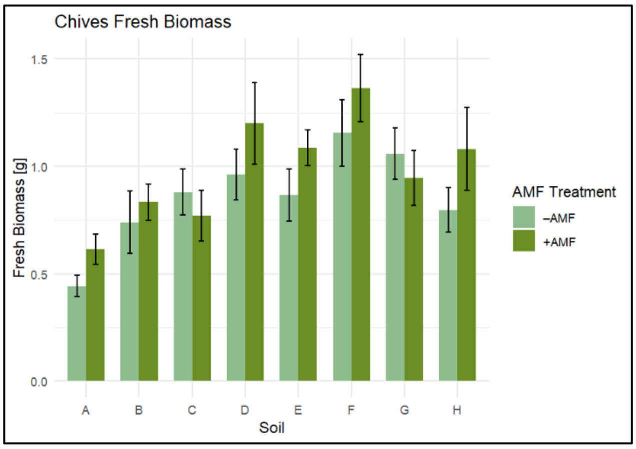

Figure 7: Fresh biomass of chives (Allium schoenoprasum L.) grown in eight different soils under control and AMF-inoculated conditions. The Figure shows mean shoot biomass for each soil, comparing non-inoculated controls (light green) and AMF-inoculated treatments (dark green). Similar trends to Thai basil were observed, particularly in soils D, G, and H, supporting the selection of these soils for further plasma-treated water (PTW) experimentation.

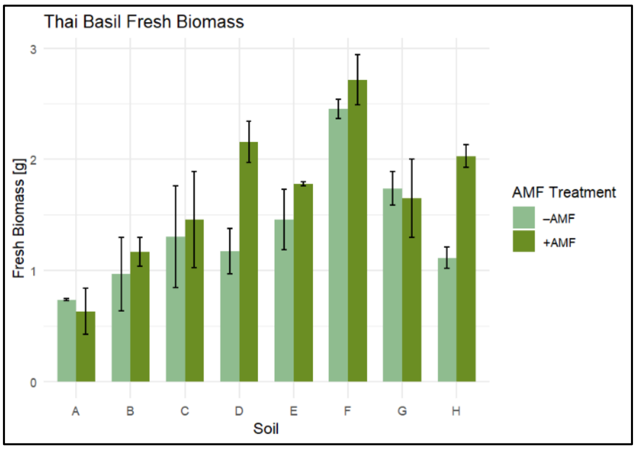

Figure 6: Fresh biomass of Thai basil (Ocimum basilicum L.) grown in eight different soils under control and AMF-inoculated conditions. The Figure displays shoot biomass under AMF-inoculated (dark green) and control (light green) treatments across soils A–H. Soils H and D showed strong positive responses to AMF inoculation, while soils C and G showed limited or negative effects. These contrasting patterns informed the selection of soils for further plasma-treated water (PTW) experimentation.

In both species, soil H showed a clearly positive biomass response to AMF inoculation, while soil D exhibited an almost significant increase. In contrast, soils C and G displayed neutral or slightly negative effects, particularly in Thai basil. These trends were consistent across both plant species, suggesting differential soil compatibility with AMF.
These findings provided a valuable reference for the subsequent experimental focus and are presented here for completeness and transparency.

3.2 Species Comparison Across Treatments

The combined ANOVA results (Table 4) show how plant species, soil, AMF inoculation, and PTW treatment influenced fresh shoot biomass across all samples. The main effect of plant species was highly significant ($F_{1, 256} = 73.12$, $p < 0.001$), confirming that Thai basil and chives differ substantially in their overall biomass production. Significant main effects were also found for soil ($F_{3, 256} = 7.07$, $p < 0.001$), AMF inoculation ($F_{1, 256} = 13.16$, $p < 0.001$), and PTW treatment ($F_{1, 256} = 19.80$, $p < 0.001$), demonstrating that each factor independently influenced plant performance.

Effect of AMF:
AMF inoculation had a significant positive effect on biomass across both plant species, although the soil × AMF interaction ($F_{3, 256} = 3.32$, $p = 0.020$) indicates that this effect varied depending on soil. The absence of a species × AMF interaction suggests that AMF had a similar directional influence (i.e., promoting growth) in both Thai basil and chives, though the magnitude and consistency of this effect were not uniform across all soils.

Effect of PTW:
PTW also significantly influenced biomass production ($F_{1, 256} = 19.80$, $p < 0.001$), but its impact was not consistent between species. A highly significant species × PTW interaction ($F_{1, 256} = 30.43$, $p < 0.001$) shows that chives and Thai basil responded differently to PTW treatment. Chives appeared to benefit more consistently from PTW across the soils tested, whereas Thai basil showed more variable or context-dependent responses.

Combined effect of AMF and PTW:
A significant three-way interaction between species, AMF, and PTW indicates that the combined effects of AMF and PTW were strongly species dependent. This suggests potential synergistic or antagonistic interactions between PTW and AMF that depend on plant identity. In contrast, non-significant interactions between plant species and soil, as

well as plant species and AMF alone, suggest that these two factors influenced Thai basil and chives in a broadly similar way.

These findings underscore the importance of plant identity in shaping treatment outcomes. While both Thai basil and chives benefitted from AMF and PTW under certain conditions, the magnitude and nature of these responses differed substantially. These species-specific differences highlight the complexity of plant–microbe–technology interactions and support the need for crop-specific optimisation when applying mycorrhizal fungi and plasma technologies.

Table 4: ANOVA summary for species comparison of fresh shoot biomass across all treatments. The model included plant species, soil, AMF inoculation, and plasma treatment (PTW), as well as all two-, three-, and four-way interactions. Significant main effects were observed for plant species, soil, AMF, and PTW. Notably, a significant interaction was found between plant species and plasma treatment, highlighting species-specific responses.

	Df	F-value	P-value
Plant species	1	73.120	<0.001
Soil	3	7.072	<0.001
AMF	1	13.161	<0.001
PTW	1	19.800	<0.001
Plant × Soil	3	2.474	0.062
Plant × AMF	1	0.798	0.373
Soil × AMF	3	3.321	0.020
Plant × PTW	1	30.433	<0.001
Soil × PTW	3	0.230	0.876
AMF × PTW	1	1.355	0.126
Plant × Soil × AMF	3	0.182	0.908
Plant × Soil × PTW	3	0.907	0.438
Plant × AMF × PTW	1	12.919	<0.001
Soil × AMF × PTW	3	1.552	0.202
Plant × Soil × AMF × PTW	3	0.934	0.425

3.3 Thai basil

This section presents the results for Thai basil, starting with biomass measurements followed by the analysis of root colonisation by AMF.

3.3.1 Biomass

The effects of AMF, PTW, and their combination on Thai basil shoot biomass were analysed using a three-way ANOVA (Table 5) including soil (C, D, G, H) as a fixed factor. The fresh shoot biomass results (Figure 8) showed similar trends to those of dry shoot biomass and root biomass (Figures 21 and 22 in the Appendix).

Effect of AMF:

The AMF treatment had a significant positive effect on fresh shoot biomass ($F_{1, 128} = 6.920$, $p = 0.0096$). Post-hoc Tukey tests confirmed that this increase was particularly significant in soil C (AMF+ vs. AMF−: $p = 0.0049$), where AMF inoculation led to the largest biomass gains compared to the control group. Other pairwise comparisons across soils did not show statistically significant differences. The full post-hoc test results are provided in Appendix D.

Effect of PTW:

The PTW treatment showed a trend toward increased biomass in some soils but did not result in a statistically significant main effect ($F_{1, 128} = 0.39$, $p = 0.536$). This finding aligns with the visual data in Figure 9, where no consistent biomass increase was observed across soils due to PTW alone.

Combined effect of AMF and PTW:

A significant AMF × PTW interaction was observed ($F_{1, 128} = 8.905$, $p = 0.0034$), indicating that the effect of AMF on biomass depended on the presence of PTW and vice versa. However, the post-hoc analysis showed that in some soils (e.g., C and H), the positive effect of AMF appeared to diminish when PTW was also applied, suggesting a potential antagonistic interaction in certain soil contexts.

Dry shoot biomass mirrored the patterns described above (Figure 21 in the Appendix). Fresh root biomass was low and less informative but followed a similar trend (Figure 22 in the Appendix).

In Thai basil, AMF inoculation generally increased biomass in two soils, though the presence of weeds may have confounded the results by competing for resources or altering root–microbe interactions.

Table 5: ANOVA results for Thai basil (Ocimum basilicum L.) fresh shoot biomass across soils and treatments. The model includes soil, AMF inoculation, and plasma treatment (PTW), as well as their interactions. Significant main effects were found for soil ($p < 0.001$) and AMF ($p < 0.01$), while PTW alone had no significant effect. A significant AMF × PTW interaction suggests context-specific responses.

	Df	F-value	P-value
Soil	3	6.036	<0.001
AMF	1	6.920	0.010
PTW	1	0.385	0.536
Soil × AMF	3	1.684	0.174
Soil × PTW	3	0.461	0.710
AMF × PTW	1	8.905	0.003
Soil × AMF × PTW	3	1.442	0.234

3.3.2 AMF Root Colonisation

Unlike the biomass results, the qPCR results for Thai basil, shown as mean copy number per mg of root tissue, indicated a significant main effect of AMF ($p = 0.0327$) and a near-significant effect of PTW ($p = 0.0607$), based on the ANOVA (Table 6).

Effect of AMF:

The presence of AMF significantly increased fungal gene copy numbers, indicating successful colonisation. However, Tukey post-hoc comparisons revealed that none of the pairwise contrasts across treatments reached statistical significance (Appendix D).

Effect of PTW:

PTW treatment showed a trend toward increased copy numbers in some soils, but this trend was not statistically significant. As shown in Figure 9, copy numbers were higher in several soils in containers treated with both PTW and AMF compared to PTW -only treatments.

Combined effect of AMF and PTW:

No significant interaction effects between AMF and PTW were observed in the ANOVA. Nonetheless, visual patterns suggest that combined treatments may have influenced colonisation more strongly than either treatment alone in some soils.

Comparing the biomass to the qPCR results (Figure 10) revealed no significant correlation. Similarly, no correlation was found between MGR values and qPCR results

Table 6: ANOVA results for qPCR-based AMF gene copy number in Thai basil (Ocimum basilicum L.) roots. The model tested the effects of soil, AMF inoculation, and plasma treatment (PTW), including their interactions. AMF and soil both had significant effects (p < 0.01), while PTW had a marginal effect (p < 0.1). A significant soil × PTW interaction suggests that the impact of plasma-treated water on AMF colonisation varied by soil.

Effect	Df	F-value	P-value	
Soil	3	1.205	0.311	
AMF	1	7.148	0.008	
PTW	1	94.956	<0.001	
Soil × AMF	3	1.941	0.126	
Soil × PTW	3	0.874	0.457	
AMF × PTW	1	4.056	0.046	
Soil × AMF × PTW	3	0.682	0.565	

These patterns in Thai basil responses raise further questions about whether similar or contrasting effects were observed in chives, a species with different root architecture.

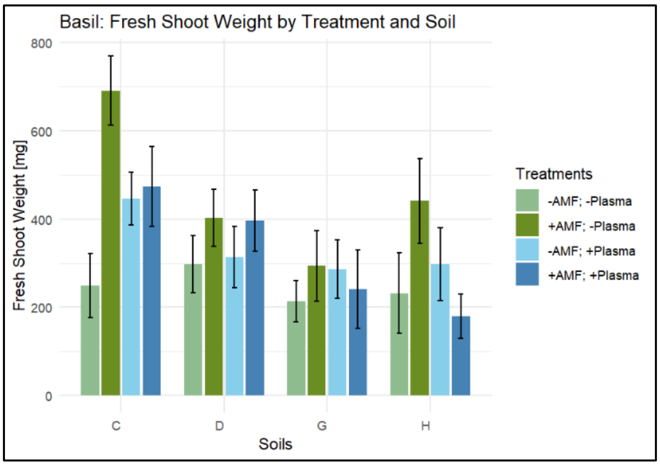

Figure 8: Fresh shoot biomass of Thai basil (Ocimum basilicum L.) under four treatment combinations across four selected soils (C, D, G, H). Bars represent mean fresh biomass (± standard error) for each treatment: control (no AMF, no PTW), AMF inoculation only, PTW treatment only, and the combination of AMF and PTW. Soils D and H exhibited positive responses to AMF inoculation, while plasma-treated water (PTW) had neutral or suppressive effects on AMF-colonised plants in some cases. The absence of synergistic biomass gains under combined treatment suggests that PTW did not enhance AMF-mediated growth in Thai basil.

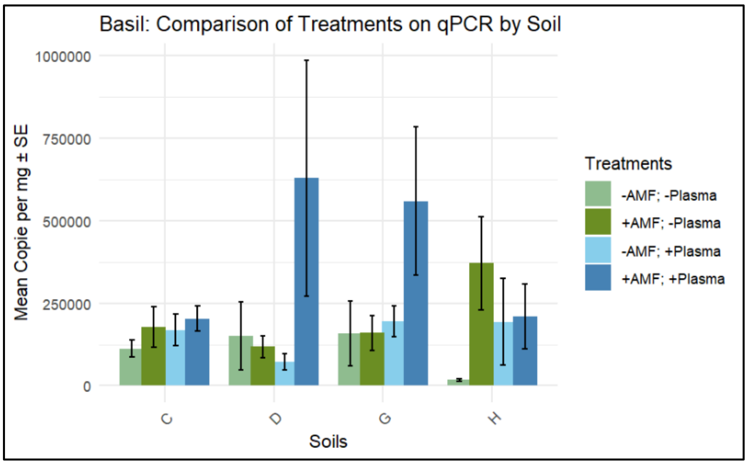

Figure 9: Quantitative PCR (qPCR) analysis of Rhizophagus irregularis gene copies in Thai basil (Ocimum basilicum L.) roots across four soils (C, D, G, H). Bars show the mean AMF gene copy number per mg root tissue (± standard error) under four treatment combinations: no AMF and no PTW, AMF only, PTW only, and AMF plus PTW. Inoculation with AMF increased colonisation in soils D and H, while PTW had variable effects. Notably, a synergistic effect of AMF and PTW on colonisation was observed in soils C and G, despite inconsistent biomass responses.

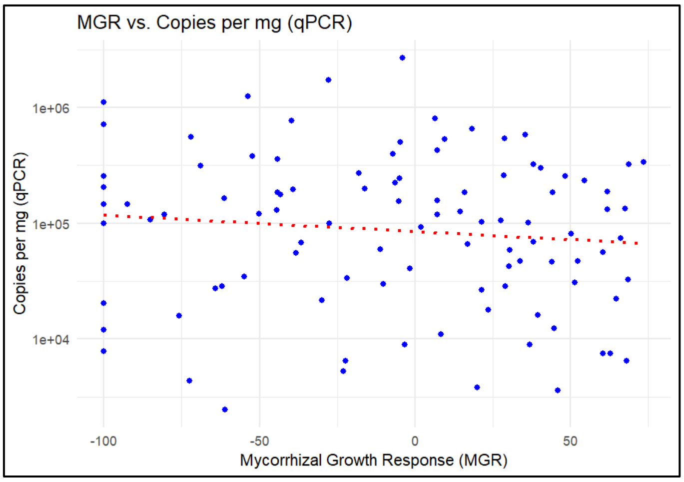

Figure 10: Correlation between Mycorrhizal Growth Response (MGR) and AMF colonisation (qPCR, copies per mg) in Thai basil. Each point represents an individual plant. The dotted red line shows the linear regression fit (slope = –863.9; p = 0.221), suggesting no significant correlation between MGR and fungal gene abundance.

3.4 Chives Results

This section summarises the findings for chives, beginning with biomass responses to the different treatments and followed by AMF root colonisation results.

3.4.1 Biomass

The analysis of fresh chive biomass yielded results that differed markedly from those observed in Thai basil.

Effect of AMF: AMF had an overall positive effect on biomass ($F_{1, 128} = 7.148$, $p = 0.0085$), as shown in Table 7. However, Tukey post-hoc comparisons revealed that AMF alone increased biomass in only one out of the four soils (soil D) when PTW was not applied. The full post-hoc results are provided in Appendix D.

Table 7: ANOVA results for fresh shoot biomass in chives (Allium schoenoprasum L.) across soils and treatments. Plasma-treated water (PTW) had a highly significant effect on biomass (p < 0.001), while AMF inoculation was also significant (p < 0.01). The AMF × PTW interaction was significant (p < 0.05), suggesting synergistic effects between microbial inoculation and PTW. Soil had no significant main effect in this model.

Effect	Df	F-value	P-value
Soil	3	1.205	0.311
AMF	1	7.148	0.008
PTW	1	94.956	<0.001
Soil × AMF	3	1.941	0.126
Soil × PTW	3	0.874	0.457
AMF × PTW	1	4.056	0.046
Soil × AMF × PTW	3	0.682	0.565

Effect of PTW:

Chives fresh shoot biomass was strongly enhanced by the application of PTW ($F_{1, 128} = 94.956$, $p < 2 \times 10^{-16}$), with a consistent pattern of increased biomass across soils.

Combined effect of AMF and PTW:

There was a significant AMF × PTW interaction ($F_{1, 128} = 4.056$, $p = 0.0461$), with biomass consistently higher in treatments with AMF when PTW had been applied. This suggests a synergistic effect, where PTW may support or enhance AMF-related growth responses in chives.

In contrast to the Thai basil results, soil did not show a significant main effect ($p = 0.3107$), suggesting that the responses in chives were more strongly influenced by treatment than by soil characteristics.

The dry shoot biomass showed a similar pattern (see Figure 30 in the Appendix). Root biomass was measured fresh and was very low; while the results were not statistically significant, they followed similar patterns to the shoot biomass (see Figure 31 in the Appendix).

In chives, PTW and AMF showed synergistic effects on growth. However, these outcomes may also reflect indirect effects of weed presence, which appeared to differ in density and impact between soils.

3.4.2 AMF Root Colonisation

Table 8: ANOVA results for qPCR-based AMF gene copy number in chives (Allium schoenoprasum L.) roots. The model includes soil, AMF inoculation, plasma-treated water (PTW), and their interactions. AMF had a highly significant effect on colonisation (p < 0.001), with soil also playing a significant role (p < 0.05). PTW alone did not significantly affect AMF gene copy numbers. No significant interactions were observed.

Effect	Df	F-value	P-value
Soil	3	0.700	0.554
AMF	1	0.172	0.679
PTW	1	28.478	<0.001
Soil × AMF	3	0.318	0.813
Soil × PTW	3	0.500	0.683
AMF × PTW	1	3.017	0.085
Soil × AMF × PTW	3	0.830	0.480

In the qPCR analysis for chives, AMF had a strong main effect ($p < 0.001$), while the effect In the qPCR analysis, AMF inoculation showed a strong main effect on AMF gene copy numbers ($p < 0.001$), whereas PTW did not reach significance ($p = 0.1237$), based on the ANOVA (Table 8).

Effect of AMF:

The presence of AMF significantly increased fungal gene copy numbers in chives, suggesting successful root colonisation. However, Tukey post-hoc tests did not reveal any statistically significant pairwise differences between individual treatment combinations. The full post-hoc results are provided in Appendix D.

Effect of PTW:

PTW treatment did not significantly influence AMF copy numbers overall. Nonetheless, as shown in Figure 12, gene copy numbers were generally higher in containers treated with both PTW and AMF than in those treated with PTW alone.

Combined effect:

No significant interaction effects were detected, indicating that AMF alone was responsible for increased colonisation, and PTW neither enhanced nor reduced this effect in a statistically significant manner.

Comparing the biomass to the qPCR results showed no significant correlation. However, comparing the MGR to the qPCR results (Figure 13) showed a slightly positive trend, although this relationship was not statistically significant.

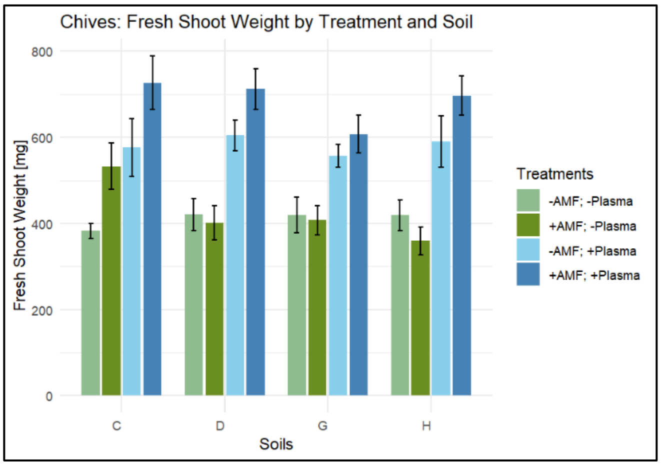

Figure 11: Fresh shoot biomass of chives (Allium schoenoprasum L.) under four treatment combinations across four soils (C, D, G, H). Bars represent mean fresh shoot biomass (± standard error) for each treatment group: control (no AMF, no PTW), AMF-only, PTW-only, and combined AMF and PTW. Across all soils, plasma-treated water (PTW) consistently increased biomass, with the strongest growth observed under the combined AMF and PTW treatment. These results suggest a synergistic effect of AMF and PTW on chive growth, contrasting with the more variable responses observed in Thai basil.

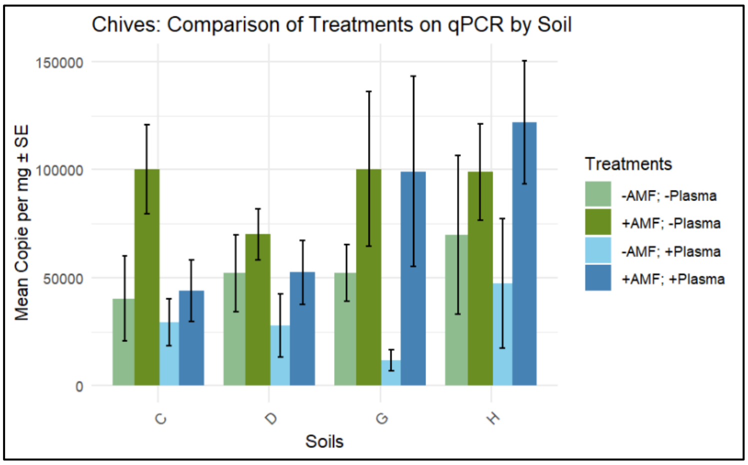

Figure 12: Quantitative PCR (qPCR) analysis of Rhizophagus irregularis gene copies in chives (Allium schoenoprasum L.) roots across four soils (C, D, G, H). Mean AMF gene copy numbers per mg root tissue (± standard error) are shown for four treatment groups: no AMF and no PTW, AMF-only, PTW-only, and combined AMF and PTW. Colonisation levels were highest in the AMF-only treatments in soils C and H, while the combined AMF + PTW treatment showed similar or slightly lower values. PTW alone did not significantly enhance colonisation, suggesting that its strong biomass-promoting effect in chives may occur independently of AMF colonisation intensity.

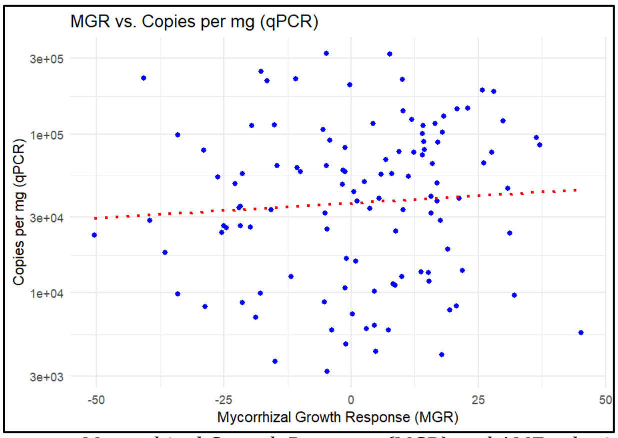

Figure 13: Correlation between Mycorrhizal Growth Response (MGR) and AMF colonisation (qPCR, copies per mg) in chives. Each point represents an individual plant. The dotted red line shows the linear regression fit (slope = 174.7; p = 0.596), indicating no significant relationship between MGR and AMF gene abundance.

3.5 Microbial Analysis

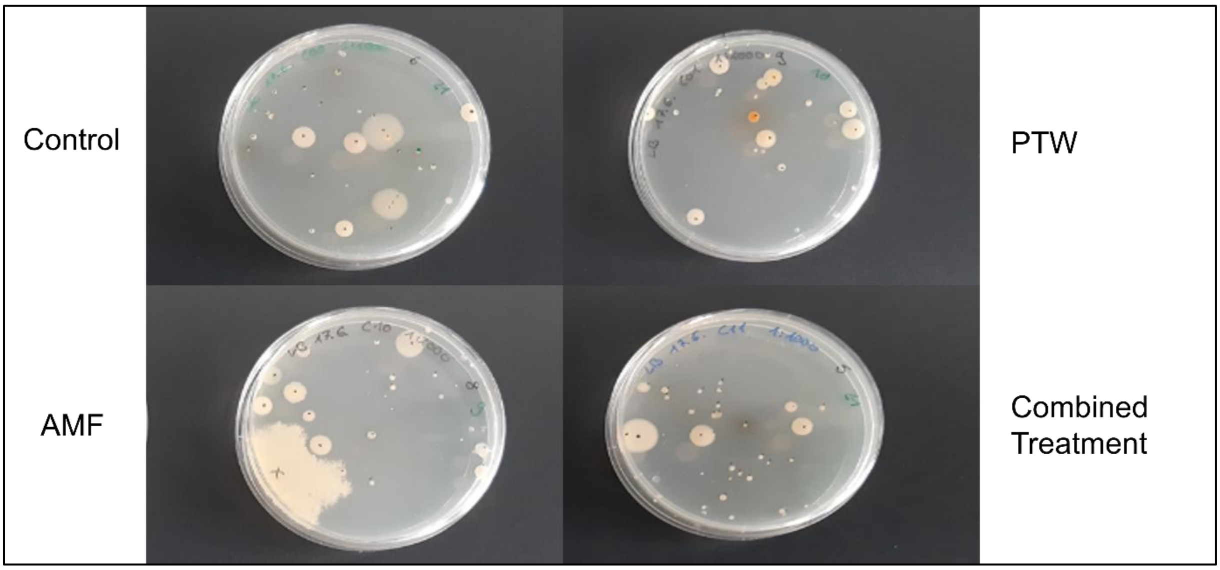

Figure 14: Representative images of microbial colonies grown on nutrient agar plates from soil samples treated with PTW and/or AMF. Plates show microbial growth from Soil C samples collected on 22.06.2024. Colony size, morphology, and abundance varied between treatments, suggesting possible treatment effects. However, due to limited replication and lack of quantitative analysis, the results are interpreted as illustrative only. Photograph by the author.

Although microbial plating was not the primary focus of this thesis, a preliminary assessment was conducted to explore whether PTW and/or AMF inoculation might influence microbial abundance and diversity in the rhizosphere. Representative agar plates are shown in Figure 14.

The microbial results proved to be inconclusive, primarily due to insufficient replication and methodological limitations. While a few initial plates hinted at potential differences in colony morphology and abundance between treatments, the dataset was not robust enough to support statistical analysis or meaningful interpretation. For instance, some plates exposed to PTW showed altered colony density or pigmentation, but these trends were inconsistent across replicates.

Nevertheless, these results are included here for completeness and transparency. Future experiments with sufficient replication could clarify whether PTW exerts selective effects on soil microbial communities. All raw images and data are available in Appendix C and D.

4. Discussion

4.1 Result interpretation

This study evaluated the influence of PTW and AMF on Thai basil and chives across four agricultural soils. The results revealed species-specific and soil-dependent effects, with notable differences in how the two plant species responded to AMF and PTW treatments.

Effects of AMF inoculation

Thai basil responded particularly well to AMF inoculation, especially in shoot biomass. These findings are consistent with earlier work by Jansa et al. (2011) and Smith and Read (2008), who attribute such benefits to improved P uptake and water relations. Interestingly, this effect did not consistently extend to root biomass. One plausible explanation, supported by Rillig et al. (2015), is that efficient nutrient uptake by AMF may lead to increased allocation of resources to aboveground growth rather than root expansion. AMF also had a significant effect on chives, although the magnitude was generally smaller compared to the effect of PTW. Soil modulated AMF responses in both species, particularly in Thai basil, reinforcing the notion that microbial symbioses are highly context dependent. While the soils were not chemically characterised in this study, differences in pH, organic matter, and nutrient levels likely contributed to the observed variation (Smith & Read, 2008).

Finally, while qPCR results showed increased AMF gene copy numbers following inoculation, these were not strongly correlated with biomass gains. This disconnect, as noted by Harrison (2005), reflects the complex and multifactorial nature of plant-fungal interactions and reinforces the view that colonisation intensity should not be used as a sole proxy for symbiotic effectiveness.

Effects of PTW treatment

PTW had a particularly strong and consistent effect on chives across biomass traits, suggesting species-specific responsiveness. In contrast, Basil showed limited responsiveness to PTW, with only minor trends toward increased biomass in some soils. These findings suggest that PTW may influence plant physiology in a species-dependent manner, possibly due to differences in nutrient uptake dynamics or oxidative stress regulation. PTW likely exerted its effects through the RONS it introduces, which have been shown to stimulate physiological processes such as enzyme activity and seedling vigour (Judée et al., 2021). In chives, this effect was robust and may relate to higher N or sulphur demand (Puligundla et al., 2018). The near-significant effect of PTW on AMF gene copy numbers (qPCR) further suggests potential microbial modulation, although this did not translate into higher colonisation or consistent biomass gains in Thai basil.

Combined effects and interactions

Significant interaction effects between AMF and PTW were observed, but not all were synergistic. In Thai basil, although a significant AMF × PTW interaction was detected (e.g., in shoot biomass), it did not result in higher biomass than AMF or PTW alone and thus cannot be interpreted as synergistic. In chives, however, the combination of PTW and AMF led to the highest biomass values, despite a notable reduction in AMF colonisation. This inverse pattern—strong biomass gains with reduced colonisation—raises interesting mechanistic questions. It is possible that PTW released a flush of nutrients into the system, particularly when combined with AMF inoculum, thereby improving plant growth independently of colonisation. Alternatively, PTW may have suppressed AMF activity directly or altered the soil microbiota in a way that reduced colonisation. While this thesis cannot resolve the underlying mechanism, the result highlights the complex and sometimes contradictory nature of AMF–plant–PTW interactions. These findings were further clarified through post-hoc Tukey tests, which confirmed that significant differences in biomass or colonisation occurred only in specific soil-treatment combinations. This reinforces the importance of soil context when applying AMF and PTW together.

Weed biomass was not significantly affected by any treatment, though a non-significant trend toward increased growth was observed in PTW-treated containers. This aligns with studies suggesting that PTW may have a general stimulatory effect on plant growth (Gierczik et al., 2020), but that this effect is not necessarily targeted or sufficient to overcome competitive dynamics in mixed plant communities.

4.2 Addressing the Research Questions

This section revisits the research questions and integrates findings, accordingly, focusing on the effects of PTW on AMF colonisation, plant biomass, and the modulating roles of species and soil.

RQ1: Does PTW influence the root colonisation of *Rhizophagus irregularis* in Thai basil and chives?

In chives, PTW addition did not increase AMF colonisation beyond levels achieved by AMF inoculation alone. Across all soils, root colonisation remained lower in treatments without AMF. While AMF inoculation clearly raised colonisation levels, the addition of PTW alone did not enhance colonisation further.

In Thai basil, a more soil-dependent pattern emerged. In two out of four soils, AMF inoculation alone increased root colonisation significantly. In these same soils, PTW also contributed positively when combined with AMF, suggesting a possible additive effect. In the remaining two soils, neither PTW nor AMF alone had a strong influence, but their combination led to a marked increase in colonisation. This indicates that the effects of PTW on AMF colonisation are highly context-dependent, influenced by both soil properties and inoculation status.

RQ2: Do PTW-induced changes in AMF colonisation affect plant biomass production?

In Thai basil, AMF inoculation led to increased shoot biomass in half of the tested soils. However, the addition of PTW to AMF treatments either reduced these biomass gains or eliminated them altogether. PTW alone only had a positive biomass effect in one of four soils, and no clear synergistic interaction between PTW and AMF was observed in basil.

In contrast, chives showed a different response pattern. While AMF inoculation alone improved biomass in just one of four soils, PTW addition consistently increased biomass across all tested soils. The highest biomass values were observed in treatments that combined PTW and AMF, indicating a synergistic interaction between the two. These findings suggest that the growth-promoting effects of PTW and AMF vary by species and depend on underlying soil conditions, nutrient availability, and possibly species-specific physiological responses.

Although AMF colonisation is often assumed to correlate with plant performance, these findings show that increased colonisation does not always lead to enhanced biomass. This supports recent calls to move beyond colonisation rates as a sole indicator of AMF functionality and consider more holistic plant-soil interactions.

RQ3: How do plant species and soil modulate the interaction between PTW and AMF?

Plant identity and soil characteristics clearly influenced the outcomes of the treatments. Thai basil exhibited stronger responses to AMF inoculation, especially in soils where AMF colonisation was high. Chives, in contrast, responded more positively to PTW, and particularly to its combination with AMF. The soil also played a major role in determining both colonisation and growth outcomes—likely due to variations in organic matter, nutrient content, and native microbial communities.

While no direct correlation was tested, differences in soil texture and humus content (see Table 1) may have contributed to the observed variability in AMF colonisation and biomass responses across soils."

These findings emphasise that the effects of PTW and AMF are not uniform but highly context-dependent, requiring treatment strategies tailored to specific plant–soil systems.

4.3 Limitations

This study provides a first assessment of the combined effects of AMF and PTW on plant growth and root colonisation by AMF. While species- and soil-specific patterns were observed, the underlying mechanisms remain unclear. A key limitation is the absence of comprehensive soil analysis; variables such as organic carbon content, nutrient availability, pH, or the presence of contaminants were not measured, yet may have significantly influenced plant responses and microbial interactions. As a result, the observed effects of PTW—particularly whether they were synergistic with AMF or merely nutrient-driven—cannot be fully disentangled. In some cases, PTW may have enhanced plant biomass by acting as a supplementary nitrogen source, independent of AMF activity. Moreover, it is possible that PTW negatively affected native AMF communities, complicating interpretation of colonisation data.

Another constraint lies in the presence of weeds, which grew alongside the experimental species and may have competed for nutrients or altered microbial dynamics. Although weed biomass remained largely unaffected by the treatments, their influence on AMF colonisation cannot be ruled out. Future experiments should consider improved weed control measures or experimental setups that eliminate potential competition.

Methodologically, while qPCR provided a reliable estimate of AMF gene abundance, it does not distinguish between active and inactive hyphal structures or confirm functional symbiosis. Additionally, the primers used in this study target general AMF DNA, not specifically the inoculated strain Rhizophagus irregularis SAF22. Combining molecular techniques with root staining or transcriptomic approaches in future work could enhance insights into AMF vitality, function, and specificity under PTW treatment.

4.4 Outlook

This study opens new avenues for integrating plasma-based technologies with microbial bioinoculants in sustainable agriculture. PTW represents a promising, low-input intervention that can influence plant–microbe interactions. When tailored to crop type and soil conditions, it may enhance AMF establishment and boost early plant performance. However, the specificity of observed effects underscores the need for system-specific calibration.

The results suggest that future research should focus on identifying the mechanisms by which PTW modifies AMF colonisation and plant responses. This includes exploring RONS signalling pathways, changing root exudation profiles, and soil microbial community shifts. Long-term trials in open-field settings and multi-season experiments are needed to validate the persistence and reproducibility of effects observed under controlled conditions.

In parallel, combining PTW with other sustainable practices—such as organic amendments, cover cropping, or intercropping—may unlock additive or synergistic benefits. From a practical standpoint, PTW may be particularly well-suited for organic herb producers, drought-prone greenhouse systems, or early-stage transplant nurseries where conventional inputs are limited or undesirable. Its compatibility with microbial inoculants, especially AMF, highlights the potential of co-applying PTW and AMF as a synergistic treatment strategy. This pairing could enhance both microbial colonisation and plant performance, offering a biologically aligned alternative to synthetic inputs in early-stage or resource-limited crop production systems.

In addition to its biological potential, PTW production is remarkably energy efficient. The wINPlas system requires little energy, making it a highly accessible option even for small-scale or decentralised agricultural operations. This low energy demand enhances its viability in low-input and off-grid contexts and underscores PTW's potential as a cost-effective and environmentally friendly treatment option.

As interest in regenerative and low-input agriculture grows, plasma-based tools like PTW may offer a versatile, scalable complement to ecological approaches in crop management. Their integration into broader soil health frameworks and nutrient cycling strategies could ultimately support more resilient and sustainable agroecosystems.

While PTW does introduce reactive N species to the soil, the concentrations and application volumes are significantly lower than those of conventional fertilizers. Nonetheless, to fully ensure environmental safety—particularly with repeated use in field systems—future research should monitor N leaching potential and evaluate long-term soil and water impacts.

5. Conclusion

This thesis explored the potential of PTW to influence ecosystem functions derived from AMF, particularly focusing on the model species *Rhizophagus irregularis*. Through greenhouse and climate chamber experiments using Thai basil and chives the study examined the interactions between PTW and AMF across four soils with differing properties. Plant biomass data and fungal colonisation assessed via qPCR were used to evaluate the outcomes of treatment combinations.

These findings demonstrate that both PTW and AMF exerted beneficial but highly context-dependent effects on plant growth and fungal colonisation. Thai basil growth was primarily shaped by soil properties and AMF inoculation, while PTW had inconsistent and in some cases counteractive effects. In contrast, chives showed stronger and more consistent responsiveness to PTW, with the combination of AMF and PTW revealing potential synergistic effects. However, these positive interactions did not consistently translate into biomass gains across all treatments. Notably, increases in plant biomass did not necessarily coincide with increases in AMF root colonisation—and in some cases, PTW strongly increased biomass while reducing AMF colonisation, especially in chives. Soil emerged as a critical moderator, underscoring the complexity of plant–soil–microbe–environment interactions.

These results partially confirm the research expectations set forth at the beginning of the study. PTW influenced AMF colonisation in a species- and soil-dependent manner, and colonisation effects were sometimes, but not always, reflected in plant biomass. The study thus contributes to a growing body of research suggesting that integrating technological innovations like PTW with microbial inoculants may enhance the ecological functionality of agricultural systems. However, the variability of responses also shows that precision is key when using such tools; what works in one plant–soil combination may not work in another.

Critically, while PTW shows promise as a novel biostimulant, its mechanism of action remains poorly understood. The roles of RONS, shifts in root exudation patterns, or changes in soil redox dynamics are plausible but unconfirmed pathways. Furthermore, the finding that PTW can increase plant biomass while reducing AMF colonisation highlights that the relationship between colonisation and functionality is not linear. This reinforces the idea that colonisation alone should not be used as a proxy for AMF effectiveness.

The absence of detailed soil nutrient and microbial community data limits the interpretability of some findings. This limitation reflects a broader challenge in integrating microbiological and biophysical variables in agroecological research. Future studies would benefit from including full soil characterisation and possibly metagenomic or metabolomic profiling.

Despite these constraints, the implications of this study are significant. PTW may offer a low-input, chemical-free intervention with the potential to improve microbial inoculant performance, particularly under the pressures of climate stress and resource limitation. Its compatibility with AMF inoculation strategies positions it as a tool worth exploring further in regenerative agriculture. In practical terms, PTW could become part of a suite of technologies used to support early plant establishment, nutrient efficiency, and microbial functionality—especially in systems that prioritise sustainability.

Future research should aim to validate these effects under field conditions, assess their long-term impacts, and refine application methods to optimise concentration, frequency, and crop specificity. Additional emphasis should also be placed on understanding the broader ecological effects of PTW, including interactions with non-target microorganisms and potential contributions to soil health over time.

With its combination of scalability, safety, and compatibility with biological systems, PTW represents a promising innovation at the interface of technology and ecology. This thesis contributes foundational insight into how it interacts with beneficial microbial symbioses and sets the stage for its further development as a sustainable agricultural tool.

Together, these findings highlight the importance of tailored, system-specific strategies when integrating microbial inoculants and novel technologies like PTW into sustainable agricultural practice.

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8. Statement of Authorship

I hereby declare that the submitted thesis is the result of my own, independent work. All external sources are explicitly acknowledged in the thesis.

Zürich, 24.04.2025

Signature: 

9. Appendix

Table of content

Abbreviations and Experimental Codes

The following codes are used throughout the appendix to describe experimental treatments, sample identifiers, and soil/plant conditions:

Soil Types

C – Clay soil

D – Dune sand

G – Garden compost soil

H – Horticultural substrate

Plant Species

B – Basil (*Ocimum basilicum*)

S – Chives (*Allium schoenoprasum*)

Treatment Codes

0 – Control (no treatment)

1 – Plasma-treated water (PTW) applied

M – Mycorrhizal inoculation (with *Rhizophagus irregularis*)

P – PTW treatment only

MP – Combined mycorrhiza + PTW treatment

Microbial Plating

LB – Lysogeny Broth Agar

YMA – Yeast Mannitol Agar

Dilutions are denoted as **1:100**, **1:1000**, **1:10000** etc., referring to serial dilutions of rhizosphere or root wash samples plated for microbial quantification.

qPCR Metadata

Plate – Indicates the qPCR plate number

AMF Colonization – Results are expressed in relative gene copy numbers (normalized) or ΔCq values depending on analysis

NTC – No Template Control (negative control)

Appendix A: Raw Data

ID	Erde	AMF	Plasma	Pflanze	Gewicht_frisch	Gewicht_trocken	Ernte	Länge [cm]	Blattpaare	Wurzeln_gewicht [mg]
C1.1	C	0	0	S	438.4	51.4	04.07.2024	15, 14.8, 14.7, 14	2	129.3
C1.2	C	0	0	S	439.9	46.6	04.07.2024	14, 13.2, 13.8	2	161.2
C2.1	C	1	0	S	606	64.7	04.07.2024	16.3, 15.9, 15.8, 15.2	2	134.6
C2.2	C	1	0	S	448.3	48.1	04.07.2024	14, 13.5, 13.8	2	305.1
D1.1	D	0	0	S	348.5	42.6	04.07.2024	16, 15.5, 15.7, 15.2	2	175.2
D1.2	D	0	0	S	325.3	39	04.07.2024	15.5, 15.8, 15.2	2	215.8
D2.1	D	1	0	S	431.8	47.7	04.07.2024	15, 14.8, 14.6, 14.7	2	113.8
D2.2	D	1	0	S	269.3	36.1	04.07.2024	14.5, 17.2, 14.3	2	203.2
G1.1	G	0	0	S	587.7	59.6	04.07.2024	16.8, 16.5, 16.3, 15.2	2	356.3
G1.2	G	0	0	S	519.4	56.1	04.07.2024	18.8, 18.6, 18.7	2	288.8
G2.1	G	1	0	S	567.3	54.8	04.07.2024	19.1, 19, 18.7	2	654.3
G2.2	G	1	0	S	300.2	28.7	04.07.2024	14.1, 14.2, 13.8, 13.7	2	127.1
H1.1	H	0	0	S	328.6	30.4	04.07.2024	15.8, 15.5, 14.9, 15.2	2	140.5
H1.2	H	0	0	S	511.1	49.8	04.07.2024	15.1, 15.2, 14.9	2	187.1
H2.1	H	1	0	S	313.6	34	04.07.2024	14.6, 14.5, 15	2	53.5
H2.2	H	1	0	S	357.6	40.5	04.07.2024	14.7, 14.8, 14.5, 14.6, 14.7	2	1066.4
C1.3	C	0	1	S	525.5	55.9	04.07.2024	15.2, 15.3, 14.9	2	189.2
C1.4	C	0	1	S	322.6	29.6	04.07.2024	15.5, 15.3, 15.2, 15	2	76.4

C2.3	C	1	1	S	476.2	40.7	04.07.2024	15.9, 15.8, 15.6	2	142.2
C2.4	C	1	1	S	530.3	52.2	04.07.2024	17, 16.8, 16.9, 16.6	2	381.5
D1.3	D	0	1	S	438.5	49.9	04.07.2024	16.1, 16, 15.9, 15.6	2	414.1
D1.4	D	0	1	S	529.1	55.5	04.07.2024	16, 15.5, 15.8, 15.9	2	272.7
D2.3	D	1	1	S	721.2	68.9	04.07.2024	18.5, 18.3, 18.5	2	460.8
D2.4	D	1	1	S	670.7	73.2	04.07.2024	14.5, 14.8, 14.4	2	2277.8
G1.3	G	0	1	S	659.2	64.1	04.07.2024	10.3, 16.2, 16	2	403.2
G1.4	G	0	1	S	583.5	51.5	04.07.2024	16.8, 16.7, 16.8	2	304
G2.3	G	1	1	S	472.7	42.7	04.07.2024	16, 15.9	2	306.9
G2.4	G	1	1	S	550.3	55	04.07.2024	16, 15.9, 15.9, 15.7	2	1172.1
H1.3	H	0	1	S	409.9	40.6	04.07.2024	14.5, 14.3, 14.5, 14.5	2	179.2
H1.4	H	0	1	S	515.1	47	04.07.2024	16.9, 16.9, 16.5, 16.7	2	647.1
H2.3	H	1	1	S	468.5	45.9	04.07.2024	17.2, 17.1, 17.2	2	1004
H2.4	H	1	1	S	621.3	57.9	04.07.2024	16.5, 16.5, 16.4, 16	2	661.1

Tabel 1: Chives, 04.07.2024

ID	Erde	AMF	Plasma	Pflanze	Gewicht_frisch	Gewicht_trocken	Ernte	Länge [cm]	Blattpaare	Wurzeln_gewicht [mg]
C001	C	0	0	B	490.5	112.55	22.07.2024	3.5, 3.5	3	2623.8
C002	C	0	0	B	592.2	105.6	22.07.2024	5.5, 4.5	8	876.9
C101	C	1	0	B	790.6	162.8	22.07.2024	4.5, 4.5	6	728.4
C102	C	1	0	B	340.1	58.7	22.07.2024	5, 2.5	4	541.3
D001	D	0	0	B	311.6	54.7	22.07.2024	3, 2, 1	3	676.3
D002	D	0	0	B	454.2	52.7	22.07.2024	6.5	9	85.3
D101	D	1	0	B	399	65.4	22.07.2024	5.5, 5	4	366
D102	D	1	0	B	647.9	114.5	22.07.2024	6, 4.5, 3.5	4	313.6
G001	G	0	0	B	361.9	42.2	22.07.2024	5.5	8	315.6
G002	G	0	0	B	377.1	62.2	22.07.2024	3.5, 3.5	4	794.8
G101	G	1	0	B	765.1	94.7	22.07.2024	5.5, 4.5	8	776.1
G102	G	1	0	B	0	0	22.07.2024	0	0	0
H001	H	0	0	B	532.4	96.8	22.07.2024	5.5, 5.5	4	1146.3
H002	H	0	0	B	455.7	50.3	22.07.2024	4.5, 2.5	4	481
H101	H	1	0	B	489	63.2	22.07.2024	5, 5	4	487
H102	H	1	0	B	118.2	22.2	22.07.2024	2.5	3	195.2
C0M1	C	0	1	B	285.8	58.6	22.07.2024	3.5, 3.5	3	1005.2
C0M2	C	0	1	B	510.2	79.6	22.07.2024	5, 5	4	407.2
C1M1	C	1	1	B	203.1	42.2	22.07.2024	3.5, 3.5	4	1033.7
C1M2	C	1	1	B	503.8	83.6	22.07.2024	5.5, 3.5, 3.5	6	148.7
D0M1	D	0	1	B	436.5	68.4	22.07.2024	4.5, 4.5	4	207.4
D0M2	D	0	1	B	323.6	43.6	22.07.2024	5.5	8	32.6
D1M1	D	1	1	B	572.3	93.1	22.07.2024	5.5, 5.5	6	274.4
D1M2	D	1	1	B	362.3	70.2	22.07.2024	5.5, 2.5	4	330.9

G0M1	G	0	1	B	431.6	57.3	22.07.2024	5, 3.5	6	591.1
G0M2	G	0	1	B	455.3	60.2	22.07.2024	4.5, 5	6	342.2
G1M1	G	1	1	B	62.2	10.4	22.07.2024	2	3	1924.1
G1M2	G	1	1	B	0	0	22.07.2024	0	0	0
H0M1	H	0	1	B	515.4	80.6	22.07.2024	4.5, 3	4	558.6
H0M2	H	0	1	B	477.9	71.3	22.07.2024	6, 3	6	498.5
H1M1	H	1	1	B	0	0	22.07.2024	0	0	0
H1M2	H	1	1	B	0	0	22.07.2024	0	0	0

Tabel 2: Basil 22.07.2024

ID	Block	Erde	AMF	Plasma	Pflanze	Gewicht_frisch	Gewicht_trocken	Ernte	Länge [cm]	Blattpaare	Wurzeln_gewicht [mg]
C00.1	1	C	0	0	S	329.8	40.6	16.07.2024	12.5	2	370.9
C00.2	2	C	0	0	S	439.5	56.8	16.07.2024	12	2	516.6
C00.3	3	C	0	0	S	329.1	48.1	16.07.2024	12.3	2	231.8
C00.4	4	C	0	0	S	344.1	46	16.07.2024	12.5	2	393.3
C00.5	5	C	0	0	S	318.8	47.9	16.07.2024	12.2	2	404.9
C00.6	6	C	0	0	S	398.5	43.8	16.07.2024	11.9	2	263.7
C00.7	7	C	0	0	S	405.6	56.6	16.07.2024	12.9	2	210
D00.1	1	D	0	0	S	306	47.3	16.07.2024	13.8	2	471.9
D00.2	2	D	0	0	S	273	43.3	16.07.2024	13.5	2	34.9
D00.3	3	D	0	0	S	453.3	61.9	16.07.2024	13.7	2	396
D00.4	4	D	0	0	S	522.3	68.4	16.07.2024	13.2	2	219.1
D00.5	5	D	0	0	S	513	65.3	16.07.2024	13.4	2	828.5
D00.6	6	D	0	0	S	455.7	59.4	16.07.2024	13.8	2	476.3
D00.7	7	D	0	0	S	589.7	77.6	16.07.2024	13.7	2	1057.5
G00.1	1	G	0	0	S	324.4	40.5	16.07.2024	14.4	2	641.7
G00.2	2	G	0	0	S	314.2	37.6	16.07.2024	14.2	2	601.1
G00.3	3	G	0	0	S	347.8	42.8	16.07.2024	14.3	2	522.7
G00.4	4	G	0	0	S	531.3	64.8	16.07.2024	13.9	2	911.2
G00.5	5	G	0	0	S	406.9	46	16.07.2024	13.8	2	859.7
G00.6	6	G	0	0	S	525.8	57.2	16.07.2024	14.2	2	1104.5
G00.7	7	G	0	0	S	223.4	27.7	16.07.2024	14.4	2	449.3
H00.1	1	H	0	0	S	464.3	82.1	16.07.2024	13.5	2	560.9
H00.2	2	H	0	0	S	554.1	67	16.07.2024	13.2	2	544.6
H00.3	3	H	0	0	S	267.7	38.7	16.07.2024	13.5	2	348.7

H00.4	4	H	0	0	S	432.2	51	16.07.2024	13.4	2	715.5
H00.5	5	H	0	0	S	517.3	60	16.07.2024	13.2	2	615.9
H00.6	6	H	0	0	S	423.5	51.5	16.07.2024	13	2	910.9
H00.7	7	H	0	0	S	275.1	34	16.07.2024	13.7	2	564.7
C01.1	1	C	0	1	S	619.9	57.7	16.07.2024	16	3	395.7
C01.2	2	C	0	1	S	472.1	45.8	16.07.2024	15.9	3	447.5
C01.3	3	C	0	1	S	698.7	68.1	16.07.2024	15.7	3	583.6
C01.4	4	C	0	1	S	983.4	92.4	16.07.2024	16	3	1565.4
C01.5	5	C	0	1	S	640.1	61.7	16.07.2024	15.9	3	536.9
C01.6	6	C	0	1	S	592.9	61.5	16.07.2024	15.6	3	955.7
C01.7	7	C	0	1	S	332.5	55.6	16.07.2024	16	3	111.1
D01.1	1	D	0	1	S	474.2	48.8	16.07.2024	18	3	364.5
D01.2	2	D	0	1	S	601	59.7	16.07.2024	17.8	3	744.1
D01.3	3	D	0	1	S	729.1	75.5	16.07.2024	17.9	3	956
D01.4	4	D	0	1	S	735.1	73.3	16.07.2024	17.5	3	863.4
D01.5	5	D	0	1	S	672.7	62.6	16.07.2024	18	3	593.3
D01.6	6	D	0	1	S	667.8	69.1	16.07.2024	17.5	3	1028.5
D01.7	7	D	0	1	S	593	64	16.07.2024	17	3	777.2
G01.1	1	G	0	1	S	617.5	68.2	16.07.2024	16.7	3	812.1
G01.2	2	G	0	1	S	464.4	46.8	16.07.2024	16.5	3	495.2
G01.3	3	G	0	1	S	419.5	38.5	16.07.2024	16.4	3	908.2
G01.4	4	G	0	1	S	611.1	58.9	16.07.2024	16.8	3	775.6
G01.5	5	G	0	1	S	555.7	54.2	16.07.2024	16.4	3	639.5
G01.6	6	G	0	1	S	592.1	50.6	16.07.2024	16.7	3	913.2
G01.7	7	G	0	1	S	511.2	53.5	16.07.2024	16.2	3	620
H01.1	1	H	0	1	S	631.9	62.6	16.07.2024	17.5	3	1023
H01.2	2	H	0	1	S	666.3	69.6	16.07.2024	17.3	3	903.4
H01.3	3	H	0	1	S	394.2	41.6	16.07.2024	17.4	3	1332

H01.4	4	H	0	1	S	363.6	33.9	16.07.2024	17.5	3	340.7
H01.5	5	H	0	1	S	684	64.4	16.07.2024	17	3	1032
H01.6	6	H	0	1	S	776.7	70.6	16.07.2024	17.6	3	874.7
H01.7	7	H	0	1	S	865.8	84.3	16.07.2024	17.4	3	1649.9
C10.1	1	C	1	0	S	337.3	38.1	16.07.2024	14.3	2	322.4
C10.2	2	C	1	0	S	439.7	51.7	16.07.2024	14	2	426.4
C10.3	3	C	1	0	S	434.7	52.5	16.07.2024	14.2	2	415.4
C10.4	4	C	1	0	S	787	86.4	16.07.2024	13.9	2	624.3
C10.5	5	C	1	0	S	795	88.8	16.07.2024	14.3	2	601.2
C10.6	6	C	1	0	S	498.6	59.5	16.07.2024	14	2	602.4
C10.7	7	C	1	0	S	449.5	62.3	16.07.2024	14.5	2	500
D10.1	1	D	1	0	S	341.2	45.8	16.07.2024	13	2	324.8
D10.2	2	D	1	0	S	297.4	41.8	16.07.2024	12.8	2	138.2
D10.3	3	D	1	0	S	322.7	45.6	16.07.2024	12.4	2	271.7
D10.4	4	D	1	0	S	536.8	65.4	16.07.2024	13	2	345
D10.5	5	D	1	0	S	614.1	67.6	16.07.2024	12.9	2	573.5
D10.6	6	D	1	0	S	324.4	33.9	16.07.2024	12.6	2	390.9
D10.7	7	D	1	0	S	475.8	63.7	16.07.2024	13.2	2	538.1
G10.1	1	G	1	0	S	248.8	30.5	16.07.2024	12.8	2	223.8
G10.2	2	G	1	0	S	375.4	49.9	16.07.2024	12.4	2	342
G10.3	3	G	1	0	S	484.8	110.8	16.07.2024	12.7	2	500.1
G10.4	4	G	1	0	S	456.5	47.6	16.07.2024	12.8	2	990.5
G10.5	5	G	1	0	S	354.8	40.8	16.07.2024	12.4	2	653
G10.6	6	G	1	0	S	390.8	49.3	16.07.2024	12.9	2	464.1
G10.7	7	G	1	0	S	488.9	52.2	16.07.2024	13	2	607.7
H10.1	1	H	1	0	S	377.1	45.5	16.07.2024	12.5	2	364.3
H10.2	2	H	1	0	S	281.4	36.7	16.07.2024	12.2	2	380.9
H10.3	3	H	1	0	S	491.8	62.1	16.07.2024	12.4	2	648.5

H10.4	4	H	1	0	S	480.3	62.1	16.07.2024	12.6	2	294.3
H10.5	5	H	1	0	S	397.5	49.1	16.07.2024	12.5	2	464.9
H10.6	6	H	1	0	S	361	39	16.07.2024	12.3	2	675.3
H10.7	7	H	1	0	S	173.9	25.6	16.07.2024	12.8	2	507.7
C11.1	1	C	1	1	S	797	75.2	16.07.2024	18	3	174.8
C11.2	2	C	1	1	S	937.7	83.7	16.07.2024	17.9	3	667.3
C11.3	3	C	1	1	S	901.5	85.3	16.07.2024	17.9	3	774.8
C11.4	4	C	1	1	S	927.1	79.4	16.07.2024	18	3	817.8
C11.5	5	C	1	1	S	776.8	71.2	16.07.2024	17.5	3	650
C11.6	6	C	1	1	S	692.6	64.4	16.07.2024	17.4	3	205.6
C11.7	7	C	1	1	S	501.9	55.7	16.07.2024	17.8	3	469.1
D11.1	1	D	1	1	S	761.6	66.6	16.07.2024	15	3	568.5
D11.2	2	D	1	1	S	878.1	78.4	16.07.2024	14.8	3	407.3
D11.3	3	D	1	1	S	543.2	48.8	16.07.2024	14.8	3	437.4
D11.4	4	D	1	1	S	741.2	60.3	16.07.2024	15	3	356.9
D11.5	5	D	1	1	S	847.6	78.8	16.07.2024	14.6	3	939.2
D11.6	6	D	1	1	S	808.5	73.6	16.07.2024	14.8	3	449
D11.7	7	D	1	1	S	437.6	45.8	16.07.2024	15	3	362.2
G11.1	1	G	1	1	S	643.9	54.3	16.07.2024	16	3	363.2
G11.2	2	G	1	1	S	704.7	58.5	16.07.2024	15.8	3	934.8
G11.3	3	G	1	1	S	533.6	48.3	16.07.2024	15.6	3	593.3
G11.4	4	G	1	1	S	584.9	51.4	16.07.2024	16	3	512.3
G11.5	5	G	1	1	S	524	46.2	16.07.2024	15.7	3	450.6
G11.6	6	G	1	1	S	901.6	78.1	16.07.2024	15.8	3	938.2
G11.7	7	G	1	1	S	552.7	52.3	16.07.2024	16	3	618.9
H11.1	1	H	1	1	S	927.1	79.4	16.07.2024	17	3	1007.6
H11.2	2	H	1	1	S	624.4	47.1	16.07.2024	16.9	3	475.6
H11.3	3	H	1	1	S	758.3	63.6	16.07.2024	16.4	3	807.9

H11.4	4	H	1	1	S	833.1	68.5	16.07.2024	16.8	3	870.5
H11.5	5	H	1	1	S	734.5	63.7	16.07.2024	16.7	3	557.5
H11.6	6	H	1	1	S	693.7	59.8	16.07.2024	17	3	775.5
H11.7	7	H	1	1	S	607.9	59.9	16.07.2024	16.8	3	1827.9

Tabel 3: Chives Experiment 2

ID	Block	Erde	AMF	Plasma	Pflanze	Gewicht_frisch	Gewicht_trocken	Ernte	Länge [cm]	Blattpaare	Wurzeln_gewicht [mg]
C00.8	8	C	0	0	B	68.9	20.5	08.07.2024	1.5, 1.5	2	106
C00.9	9	C	0	0	B	66.5	8.8	08.07.2024	1.5, 1	2	33.2
C00.10	10	C	0	0	B	21.7	3.4	08.07.2024	0.5	1	15.5
C00.11	11	C	0	0	B	14.2	6.8	08.07.2024	0.5, 1	1	64.3
C00.12	12	C	0	0	B	312.7	50.2	08.07.2024	4.5, 3.5, 3	3	92.5
C00.13	13	C	0	0	B	261.2	38.1	08.07.2024	4, 3.5	3	111.9
C00.14	14	C	0	0	B	409.7	62.8	08.07.2024	4.5, 3.2, 3	3	91.9
D00.8	8	D	0	0	B	12.1	11	08.07.2024	0.5	1	56.8
D00.9	9	D	0	0	B	167.4	28.1	08.07.2024	2.5, 2.1	2	134.9
D00.10	10	D	0	0	B	47.3	14.1	08.07.2024	1, 0.5, 0.5	1	14
D00.11	11	D	0	0	B	255.5	48.9	08.07.2024	3, 3, 2.5	2	50.5
D00.12	12	D	0	0	B	521.8	81.5	08.07.2024	4.5, 4.5, 4, 1	2	25.8
D00.13	13	D	0	0	B	372.9	46.3	08.07.2024	4, 2.7	3	37.9
D00.14	14	D	0	0	B	531.5	71.5	08.07.2024	4,5, 3, 3	3	195.3
G00.8	8	G	0	0	B	70.9	11.7	08.07.2024	1.5, 1.5	2	29.5
G00.9	9	G	0	0	B	97.1	19.2	08.07.2024	2.5, 1.8	2	35.1
G00.10	10	G	0	0	B	252.9	24.8	08.07.2024	3.5, 2.5, 1.8	3	316
G00.11	11	G	0	0	B	0	0	08.07.2024	4.5, 3.5, 2	0	0

G00.12	12	G	0	0	B	313.6	48.8	08.07.2024	4.5, 4.5, 2.5	3	164
G00.13	13	G	0	0	B	327.4	48.8	08.07.2024	3	3	479.2
G00.14	14	G	0	0	B	121.1	14.4	08.07.2024	4.3, 4.2	3	175.1
H00.8	8	H	0	0	B	0	0	08.07.2024	0	0	0
H00.9	9	H	0	0	B	0	0	08.07.2024	0	0	0
H00.10	10	H	0	0	B	52.9	14	08.07.2024	1.5	2	390.1
H00.11	11	H	0	0	B	384.4	51.4	08.07.2024	4, 2.5	3	117.1
H00.12	12	H	0	0	B	661.1	110.4	08.07.2024	5.5, 5.5, 2	3	520.7
H00.13	13	H	0	0	B	0	0	08.07.2024	0	0	0
H00.14	14	H	0	0	B	0	0	08.07.2024	0	0	0
C01.8	8	C	0	1	B	195	36.9	08.07.2024	3.5, 0.5	3	87.3
C01.9	9	C	0	1	B	301.5	37	08.07.2024	3.5, 2.5	2	6.8
C01.10	10	C	0	1	B	561.1	78.8	08.07.2024	3.5, 3.5, 3, 1.5	3	4
C01.11	11	C	0	1	B	637.4	86.6	08.07.2024	5, 4.5, 3	3	29.6
C01.12	12	C	0	1	B	395.5	64.1	08.07.2024	5, 3, 3	3	274.1
C01.13	13	C	0	1	B	742.1	92.8	08.07.2024	5.5, 5.5, 2.5	3	56.5
C01.14	14	C	0	1	B	382.2	62	08.07.2024	4, 3.5, 3.5	2	1700.1
D01.8	8	D	0	1	B	148.9	25.2	08.07.2024	2.5, 1.5	2	7
D01.9	9	D	0	1	B	139.3	16.9	08.07.2024	3, 1.5	2	46
D01.10	10	D	0	1	B	280	32.2	08.07.2024	2.5, 2	3	29.6
D01.11	11	D	0	1	B	334.1	51.9	08.07.2024	4, 3, 1.5	2	28.1
D01.12	12	D	0	1	B	261.8	34.2	08.07.2024	3, 2.5	2	6.2
D01.13	13	D	0	1	B	111	15.9	08.07.2024	3	3	24.1

D01.14	14	D	0	1	B	793.3	111	08.07.2024	5, 3.5, 3.5, 3	3	29.5
G01.8	8	G	0	1	B	0	0	08.07.2024	0	0	0
G01.9	9	G	0	1	B	179	23	08.07.2024	3.5	3	9.7
G01.10	10	G	0	1	B	0	0	08.07.2024	0	0	0
G01.11	11	G	0	1	B	285	35.2	08.07.2024	3.5, 2	3	189.9
G01.12	12	G	0	1	B	462.9	63.5	08.07.2024	4, 3.5, 3	3	231.8
G01.13	13	G	0	1	B	244.9	34	08.07.2024	3.5, 3, 2	2	468.5
G01.14	14	G	0	1	B	516.7	67.6	08.07.2024	4,3,2.5	3	258.4
H01.8	8	H	0	1	B	0	0	08.07.2024	0	0	0
H01.9	9	H	0	1	B	199.5	23.5	08.07.2024	3.5	3	75
H01.10	10	H	0	1	B	598.9	72	08.07.2024	5, 5	2	247.3
H01.11	11	H	0	1	B	427.2	48.8	08.07.2024	6	5	124.4
H01.12	12	H	0	1	B	0	0	08.07.2024	0	0	0
H01.13	13	H	0	1	B	453.9	54.8	08.07.2024	3, 5.5	3	250.1
H01.14	14	H	0	1	B	0	0	08.07.2024	0	0	0
C10.8	8	C	1	0	B	832.3	118.8	08.07.2024	5.5, 5, 4, 3.5	3	93.3
C10.9	9	C	1	0	B	838	119.3	08.07.2024	5.5, 4, 3.5	3	8.3
C10.10	10	C	1	0	B	1029	171.6	08.07.2024	6, 5.5, 5, 4	3	79.5
C10.11	11	C	1	0	B	788.8	144.4	08.07.2024	5.5, 5.5, 4.5, 4	3	393.8
C10.12	12	C	1	0	B	642.3	99.7	08.07.2024	5, 4, 4, 3.5	3	85.9
C10.13	13	C	1	0	B	632.7	88	08.07.2024	4.5, 4.5, 4, 4	2	172.2

C10.14	14	C	1	0	B	318	43.2	08.07.2024	1.5, 1.5, 1.5, 1.5	3	130.2
D10.8	8	D	1	0	B	462.5	64	08.07.2024	4.5, 4.5, 2.5	2	8.5
D10.9	9	D	1	0	B	52.8	7.8	08.07.2024	0.5	3	181.8
D10.10	10	D	1	0	B	562.6	86	08.07.2024	6, 4	3	97.2
D10.11	11	D	1	0	B	372.4	57.8	08.07.2024	4, 3, 2.5	3	14.1
D10.12	12	D	1	0	B	541.3	75.6	08.07.2024	5.5, 4.5, 0.5	5	14.3
D10.13	13	D	1	0	B	447.4	55.6	08.07.2024	6	2	113.7
D10.14	14	D	1	0	B	136.4	12.7	08.07.2024	1, 1	3	82.6
G10.8	8	G	1	0	B	185.4	32.6	08.07.2024	4	3	62
G10.9	9	G	1	0	B	532.2	81.5	08.07.2024	6.5, 2, 2	2	592.5
G10.10	10	G	1	0	B	252.2	51.7	08.07.2024	3, 3, 2.5, 1	3	664.6
G10.11	11	G	1	0	B	294.9	48.4	08.07.2024	5.5, 2.5, 1	2	1052.1
G10.12	12	G	1	0	B	156.8	32.3	08.07.2024	2.5, 2.5, 1.5	2	370.8
G10.13	13	G	1	0	B	74.3	14	08.07.2024	3.5	3	1220.4
G10.14	14	G	1	0	B	382.7	46.9	08.07.2024	4.5, 3.5, 3	3	438.6
H10.8	8	H	1	0	B	504.2	72.1	08.07.2024	6, 2.5	3	54
H10.9	9	H	1	0	B	175.8	27.9	08.07.2024	4	5	122.5
H10.10	10	H	1	0	B	311.8	44	08.07.2024	6	5	945.5
H10.11	11	H	1	0	B	784.6	105.7	08.07.2024	6, 2.5	5	647.1
H10.12	12	H	1	0	B	571	68.7	08.07.2024	6, 4	2	1216.4
H10.13	13	H	1	0	B	108.1	17.9	08.07.2024	2.5	10	382.9

H10.14	14	H	1	0	B	904	114.6	08.07.2024	8	5	1040.8
C11.8	8	C	1	1	B	224.2	43.9	08.07.2024	2.5, 2, 1.5	2	82.6
C11.9	9	C	1	1	B	190.1	25.7	08.07.2024	4.5	3	48.1
C11.10	10	C	1	1	B	336.7	61.7	08.07.2024	4.5, 3, 3	3	799.1
C11.11	11	C	1	1	B	510.1	62.9	08.07.2024	4, 4.5	3	317.7
C11.12	12	C	1	1	B	838	124	08.07.2024	7, 6.5, 6.5	5	459.9
C11.13	13	C	1	1	B	521.3	58.9	08.07.2024	7	7	228.3
C11.14	14	C	1	1	B	939.8	167.8	08.07.2024	6, 5.5, 5.5, 4.5	3	170.6
D11.8	8	D	1	1	B	182.2	31.1	08.07.2024	2, 2, 1	2	99.8
D11.9	9	D	1	1	B	184.5	32	08.07.2024	2, 2, 1	2	8.2
D11.10	10	D	1	1	B	386	42.3	08.07.2024	5	7	14.4
D11.11	11	D	1	1	B	278.2	34.7	08.07.2024	2.5, 2.5	2	27.1
D11.12	12	D	1	1	B	280.5	42.6	08.07.2024	4.5, 4	3	379.1
D11.13	13	D	1	1	B	830.9	126	08.07.2024	6, 5, 4, 4	3	365.4
D11.14	14	D	1	1	B	483.9	68.6	08.07.2024	5.5, 3.5	7	319
G11.8	8	G	1	1	B	46.8	11.2	08.07.2024	1	2	91.5
G11.9	9	G	1	1	B	342.8	54.6	08.07.2024	4.5, 4, 3.5	2	561.4
G11.10	10	G	1	1	B	418.3	62.7	08.07.2024	5.5, 5	3	290.6
G11.11	11	G	1	1	B	110.2	40.8	08.07.2024	2	2	64.5
G11.12	12	G	1	1	B	852.5	80.5	08.07.2024	6.5, 5.5, 5	5	792.6
G11.13	13	G	1	1	B	169.6	21.1	08.07.2024	4.5	3	269.8
G11.14	14	G	1	1	B	165.3	21.2	08.07.2024	3.5, 1.5	3	323.2
H11.8	8	H	1	1	B	0	0	08.07.2024	0	3	0

H11.9	9	H	1	1	B	262.9	32	08.07.2024	4.5	3	927
H11.10	10	H	1	1	B	210.9	70.6	08.07.2024	3.5, 3	3	839.7
H11.11	11	H	1	1	B	167.4	35.3	08.07.2024	3.5	3	437.8
H11.12	12	H	1	1	B	294.2	49.6	08.07.2024	4.5, 3.5	3	68.8
H11.13	13	H	1	1	B	269.7	42.6	08.07.2024	5.5	7	264.2
H11.14	14	H	1	1	B	413	63.6	08.07.2024	6.5	3	211.5

Tabel 4: Basil Experiment 2

19.06.2024				
	C	D	G	H
unv. 100				
1: 100 100	39	44	11	23
1:100 200	61	81	34	48
1:1000 100	2	4	2	5
1:1000 200	9	5	1	6
20.06.2024				
	C	D	G	H
unv. 100				
1: 100 100	57	13	20	36
1:100 200	48	53	6	34
1:1000 100	14	5	1	20
1:1000 200	27	19	4	16
21.06.2024				
	C	D	G	H
unv. 100				
1: 100 100	20	0	3	6
1:100 200	11	8		0
1:1000 100	12	1	0	4
1:1000 200	2	4	2	1
24.06.2024				
	C	D	G	H
unv. 100				
1: 100 100		2	1	0
1:100 200	5	13		
1:1000 100	4	3	3	2
1:1000 200	1	4	1	2

Tabel 5: LB, MiBi 19.6.24-24.6.24

19.06.2024				
	C	*D*	*G*	*H*
unv. 100				
1: 100 100	*36*	*54*	*23*	*41*
1:100 200	*66*	*115*	*39*	*60*
1:1000 100	*7*	*4*	*3*	*5*

1:1000 200	*7*	*14*	*4*	*8*
20.06.2024				
	C	*D*	*G*	*H*
unv. 100				
1: 100 100	*144*	*116*	*50*	*78*
1:100 200	*-*	*-*	*74*	*133*
1:1000 100	*17*	*15*	*5*	*18*
1:1000 200	*25*	*38*	*12*	*13*
21.06.2024				
	C	*D*	*G*	*H*
unv. 100				
1: 100 100	*-*	*10*	*11*	*16*
1:100 200	*38*	*8*	*8*	*16*
1:1000 100	*24*	*5*	*4*	*4*
1:1000 200	*20*	*5*	*7*	*5*
24.06.2024				
	C	*D*	*G*	*H*
unv. 100				
1: 100 100		*-*	*15*	*28*
1:100 200	*5*	*-*	*-*	*-*
1:1000 100	*4*	*1*	*3*	*15*
1:1000 200	*1*	*17*	*14*	*13*

Tabel 6: YMA MiBi 19.6.24-24.6.24

24.07.2024	LB, 100, 1	LB, 100, 2	LB 1000, 1	LB 1000, 2	YMA 100, 1	YMA 100,2	YMA 1000, 1	YMA 1000, 2
C00	70	74	2	6	153	174	6	20
C01	112	105	11	9	145	150	17	7
C10	63	65	8	8	96	115	7	8
C11	94	59	6	5	110	101	14	8
G00	51	54	5	6	86	112	8	8
G01	49	60	6	9	96	70	5	11
25.07.2024	LB, 100, 1	LB, 100, 2	LB 1000, 1	LB 1000, 2	YMA 100, 1	YMA 100,2	YMA 1000, 1	YMA 1000, 2
C00	78	48	13	21	-	-	27	35
C01	-	-	9	10	-	-	30	32
C10	52	61	14	9	-	-	23	21
C11	60	25	38	21	-	-	37	34
G00	35	38	13	14	-	-	33	39
G01	39	47	7	7	-	-	20	17
26.07.2024	LB, 100, 1	LB, 100, 2	LB 1000, 1	LB 1000, 2	YMA 100, 1	YMA 100,2	YMA 1000, 1	YMA 1000, 2
C00	-	-	10	3	-	-	11	10
C01	-	-	4	6	-	-	16	12
C10	13	-	8	10	-	-	56	52

C11	10	10	8	12	-	-	23	25
G00	5	0	6	5	-	-	14	6
G01	10	9	5	7	-	-	14	15

Tabel 12: MicroBio, 24.7.-26.7.24

Tabel 7: qPCR Basil

ID	Idlang	Erde	AMF	Plasma	Pflanze	probe mg	Sample qPCR	Plate	Konzentration (1:50)	Average CQ	Volume	Copiepermg
164	H01.10	H	1	0	B	10	59	Plate 2	12.2	30	100	3594.5
266	G002	G	0	1	B	1	43	Plate 3	12.4	25	100	30916.5
278	D0M2	D	0	1	B	1.1	48	Plate 3	12.7	35	100	40476.3
204	D11.8	D	1	1	B	2	88	Plate 2	12.9	33.5204121	100	21562.7
263	D101	D	0	0	B	1	40	Plate 3	13.5	44	100	58870.6
136	H00.10	H	0	1	B	10	31	Plate 2	13.9	18	100	2437.3
191	H10.9	H	1	1	B	5	80	Plate 2	14.1	23	100	6462.2
279	D1M1	D	1	1	B	1	49	Plate 3	15.8	30	100	47093.3
283	G1M1	G	0	0	B	8	52	Plate 3	16.1	22	100	4377.1
165	H01.11	H	1	0	B	8	60	Plate 2	16.4	19	100	3821.9
179	D10.11	D	0	0	B	1	72	Plate 2	17.8	58	100	102981.4
223	H11.13	H	0	0	B	9	4	Plate 3	17.8	55	100	10926.2
145	C01.12	C	0	1	B	6	40	Plate 2	19.0	28	100	8961.4
213	G11.10	G	0	0	B	5	94	Plate 2	19.0	42.1135258	100	16012.7
264	D102	D	0	0	B	9	41	Plate 3	21.3	32	100	7476.5
157	G01.10	G	1	0	B	8	52	Plate 2	22.2	28	100	7787.2
280	D1M2	D	1	1	B	7	50	Plate 3	24.5	26	100	8985.5
218	H11.8	H	0	0	B	6	1	Plate 3	24.8	49	100	20346.8
222	H11.12	H	0	0	B	5	3	Plate 3	25.4	52	100	26660.4
220	H11.10	H	0	0	B	10	2	Plate 3	25.7	48	100	12266.9
261	D001	D	1	0	B	2	38	Plate 3	37.7	35	100	65539.2
267	G101	G	1	1	B	17	44	Plate 3	39.8	28	100	6463.9
149	D01.9	D	0	1	B	5	44	Plate 2	48.7	29	100	28409.0
152	D01.12	D	0	1	B	12	47	Plate 2	50.3	13	100	5296.1
269	H001	H	0	1	B	10	45	Plate 3	50.7	15	100	7465.7

120	D00.8	D	1	0	B	12	15	Plate 2	72.2	27	100	15943.6
153	D01.13	D	0	1	B	10	48	Plate 2	87.0	31.3842085	100	27309.3
172	C10.11	C	1	1	B	9	67	Plate 2	106.5	27	100	32356.7
176	D10.8	D	0	0	B	17	71	Plate 2	129.2	37	100	28361.0
216	G11.13	G	0	0	B	3	96	Plate 2	130.4	42	100	183818.1
190	H10.8	H	1	1	B	6	79	Plate 2	138.5	35.3023846	100	81500.9
144	C01.11	C	0	1	B	22	39	Plate 2	142.2	27.5605595	100	17812.7
214	G11.11	G	0	0	B	1	95	Plate 2	152.7	27.9641353	100	426981.8
281	G0M1	G	1	0	B	5	51	Plate 3	179.5	13	100	46674.2
160	G01.13	G	1	0	B	17	55	Plate 2	183.4	28	100	29740.2
161	G01.14	G	1	0	B	11	56	Plate 2	187.2	27	100	46381.0
128	G00.9	G	0	1	B	9	23	Plate 2	199.2	31	100	68149.7
129	G00.10	G	0	1	B	3	24	Plate 2	212.9	38	100	269939.5
137	H00.11	H	0	1	B	11	32	Plate 2	213.0	22	100	42652.3
140	H00.14	H	0	1	B	17	35	Plate 2	217.5	9	100	11983.8
202	C11.13	C	0	0	B	12	87	Plate 2	223.1	31.8079569	100	59147.7
113	C00.8	C	1	0	B	13	8	Plate 2	242.0	19	100	34523.0
207	D11.11	D	1	1	B	10	91	Plate 2	251.8	13.2629777	100	33402.0
132	G00.13	G	0	1	B	11	27	Plate 2	272.1	28	100	69298.5
121	D00.9	D	1	0	B	14	16	Plate 2	276.7	28	100	55408.9
193	H10.11	H	1	1	B	13	82	Plate 2	296.8	32.51448	100	74238.0
209	D11.13	D	1	1	B	25	93	Plate 2	315.8	17.6777807	100	22329.8
169	C10.8	C	1	1	B	5	64	Plate 2	339.9	28	100	187586.7
206	D11.10	D	1	1	B	2	90	Plate 2	364.9	28	100	502517.9
182	D10.14	D	0	0	B	3	74	Plate 2	371.3	45	100	557252.1
147	C01.14	C	0	1	B	4	42	Plate 2	405.9	22.143686	100	224697.2
192	H10.10	H	1	1	B	2	81	Plate 2	405.9	32	100	651353.6
183	G10.8	G	1	1	B	10	75	Plate 2	437.3	36	100	156676.8

125	D00.13	D	1	0	B	14	20	Plate 2	473.9	27	100	93013.9
148	D01.8	D	0	1	B	5	43	Plate 2	501.2	18	100	177456.7
146	C01.13	C	0	1	B	6	41	Plate 2	549.1	28	100	257460.6
141	C01.8	C	0	1	B	13	36	Plate 2	570.5	29.4060439	100	129040.2
124	D00.12	D	1	0	B	9	19	Plate 2	589.7	28	100	183619.4
205	D11.9	D	1	1	B	1	89	Plate 2	602.4	29	100	1727145.6
189	G10.14	G	1	1	B	1	78	Plate 2	602.7	9.57037042	100	576842.0
134	H00.8	H	0	1	B	10	29	Plate 2	623.8	23	100	145943.9
142	C01.9	C	0	1	B	5	37	Plate 2	640.6	28	100	357901.8
156	G01.9	G	1	0	B	9	51	Plate 2	642.7	27.4300237	100	195872.1
122	D00.10	D	1	0	B	6	17	Plate 2	661.6	28	100	312221.0
143	C01.10	C	0	1	B	10	38	Plate 2	670.1	28	100	184445.1
208	D11.12	D	1	1	B	1	92	Plate 2	676.8	39.3731878	100	2664744.2
133	G00.14	G	0	1	B	5	28	Plate 2	682.7	28	100	378245.6
131	G00.12	G	0	1	B	6	26	Plate 2	704.5	28	100	323066.2
123	D00.11	D	1	0	B	17	18	Plate 2	713.5	28.2557222	100	118585.5
158	G01.11	G	1	0	B	5	53	Plate 2	714.7	28	100	396022.0
200	C11.11	C	0	0	B	23	85	Plate 2	723.7	48.8383524	100	153680.8
195	H10.13	H	1	1	B	6	83	Plate 2	723.7	9.95866331	100	120125.8
196	H10.14	H	1	1	B	8	84	Plate 2	723.7	36	100	322324.1
150	D01.10	D	0	1	B	14	45	Plate 2	734.9	18.9366807	100	99401.0
166	H01.12	H	1	0	B	2	61	Plate 2	743.5	19	100	714600.2
127	G00.8	G	0	1	B	12	22	Plate 2	749.4	26	100	163886.1
114	C00.9	C	1	0	B	20	9	Plate 2	775.8	30.5821422	100	118633.8
187	G10.12	G	1	1	B	2	76	Plate 2	776.1	21	100	801614.3
167	H01.13	H	1	0	B	4	62	Plate 2	778.1	28	100	537221.2
130	G00.11	G	0	1	B	8	25	Plate 2	778.5	26	100	253809.6
116	C00.11	C	1	0	B	22	11	Plate 2	836.0	28	100	106690.6

162	H01.8	H	1	0	B	11	57	Plate 2	839.2	26.8212799	100	204632.2
115	C00.10	C	1	0	B	17	10	Plate 2	845.2	29	100	145660.4
171	C10.10	C	1	1	B	7	66	Plate 2	846.8	28	100	338513.5
159	G01.12	G	1	0	B	8	54	Plate 2	881.4	27	100	300638.1
118	C00.13	C	1	0	B	13	13	Plate 2	896.7	29	100	198029.9
126	D00.14	D	1	0	B	16	21	Plate 2	902.0	18	100	100205.4
119	C00.14	C	1	0	B	16	14	Plate 2	911.3	19	100	106202.6
174	C10.13	C	1	1	B	7	69	Plate 2	913.5	20	100	256520.9
151	D01.11	D	0	1	B	13	46	Plate 2	938.8	17	100	126365.2
155	G01.8	G	1	0	B	10	50	Plate 2	952.5	27	100	255831.1
175	C10.14	C	1	1	B	13	70	Plate 2	957.2	33	100	244822.1
139	H00.13	H	0	1	B	18	34	Plate 2	959.9	19	100	99308.2
117	C00.12	C	1	0	B	6	12	Plate 2	963.3	33	100	530583.8
188	G10.13	G	1	1	B	3	77	Plate 2	1002.1	38	100	1253632.2
173	C10.12	C	1	1	B	8	68	Plate 2	1029.4	18	100	233103.4
170	C10.9	C	1	1	B	25	65	Plate 2	1188.1	28	100	131666.9
135	H00.9	H	0	1	B	2	30	Plate 2	1220.9	18	100	1101870.2
138	H00.12	H	0	1	B	16	33	Plate 2	1286.7	17	100	133856.6
163	H01.9	H	1	0	B	5	58	Plate 2	1390.4	27	100	761785.5
203	C11.14	C	0	0	B	12	88	Plate 2	243.1	41.8079569	100	56147.7
204	C11.15	C	0	0	B	23	89	Plate 2	763.7	38.8383524	100	193680.8
205	C11.16	C	0	0	B	12	90	Plate 2	228.1	39.8079569	100	59197.7
206	C11.17	C	0	0	B	23	91	Plate 2	725.7	42.8383524	100	153780.8

Tabel 8: chives qPCR

ID	Idlang	Erde	AMF	Plasma	Pflanze	probe mg	Sample qPCR	Plate	Konzentration (1:50)	**Average CQ**	Volume	Copiepermg
228	C2.2	C	0	0	S	3	7	Plate 3	15.0	22	100	10792.3
61	C10.5	C	0	0	S	10	61	Plate 1	15.6	36	100	5622.3
231	D2.1	D	0	0	S	5	9	Plate 3	17.4	11	100	3702.5
239	H2.1	H	0	0	S	5	16	Plate 3	20.4	24	100	9805.7
233	G1.1	G	1	0	S	4	10	Plate 3	31.2	10	100	7810.4
59	C10.3	C	0	0	S	18	53	Plate 1	38.8	27	100	5814.6
66	D10.3	D	0	0	S	16	85	Plate 1	46.9	24	100	7031.3
58	C10.2	C	0	0	S	3	45	Plate 1	64.2	26	100	55608.6
57	C10.1	C	0	0	S	5	37	Plate 1	67.3	26	100	34973.6
74	G10.4	G	0	0	S	16	46	Plate 1	100.7	26	100	16370.2
13	D00.6	D	1	0	S	6	2	Plate 1	102.3	23	100	39225.4
7	C00.7	C	1	0	S	2	49	Plate 1	105.7	19	100	100410.1
71	G10.1	G	0	0	S	15	30	Plate 1	107.3	25	100	17879.9
78	H10.1	H	0	0	S	23	78	Plate 1	121.1	24	100	12636.0
72	G10.2	G	0	0	S	9	38	Plate 1	133.5	23	100	34114.0
80	H10.3	H	0	0	S	9	94	Plate 1	141.4137751	24	100	37710.3
12	D00.5	D	1	0	S	3	89	Plate 1	146.5827748	23	100	112380.1
235	G2.1	G	0	0	S	5	12	Plate 3	164.1	23	100	76530.0
8	D00.1	D	1	0	S	10	57	Plate 1	166.3	20	100	33251.2
14	D00.7	D	1	0	S	5	10	Plate 1	174.2	22	100	76658.8
16	G00.2	G	1	0	S	17	18	Plate 1	179.0	25	100	26317.8
65	D10.2	D	0	0	S	12	77	Plate 1	179.5	16	100	23934.4
84	H10.7	H	0	0	S	18	31	Plate 1	181.4	23	100	23177.1
1	C00.1	C	1	0	S	2	1	Plate 1	196.0	22	100	215629.4
67	D10.4	D	0	0	S	4	93	Plate 1	198.1372515	18	100	89161.8
5	C00.5	C	1	0	S	9	33	Plate 1	203.9	26	100	58897.4
81	H10.4	H	0	0	S	13	7	Plate 1	206.3	31	100	49196.5

62	C10.6	C	0	0	S	4	69	Plate 1	207.2	25	100	129470.7
76	G10.6	G	0	0	S	10	62	Plate 1	218.6	23	100	50280.8
79	H10.2	H	0	0	S	6	86	Plate 1	225.7	21	100	78988.3
6	C00.6	C	1	0	S	7	41	Plate 1	238.7	17	100	57962.9
69	D10.6	D	0	0	S	15	14	Plate 1	252.5	17	100	28611.2
77	G10.7	G	0	0	S	13	70	Plate 1	260.1	28	100	56031.3
70	D10.7	D	0	0	S	5	22	Plate 1	267.0	23	100	122838.7
17	G00.3	G	1	0	S	3	26	Plate 1	267.7	25	100	223108.6
24	H00.3	H	1	0	S	25	74	Plate 1	274.2	24	100	26326.9
75	G10.5	G	0	0	S	8	54	Plate 1	276.0	33	100	113832.1
83	H10.6	H	0	0	S	25	23	Plate 1	280.1	23	100	25765.2
18	G00.4	G	1	0	S	4	34	Plate 1	289.2	26	100	187970.5
3	C00.3	C	1	0	S	9	17	Plate 1	295.3	25	100	82021.8
19	G00.5	G	1	0	S	9	42	Plate 1	315.7	26	100	91196.5
10	D00.3	D	1	0	S	10	73	Plate 1	322.1	24	100	77307.8
26	H00.5	H	1	0	S	11	90	Plate 1	323.768678	25	100	73583.8
20	G00.6	G	1	0	S	13	50	Plate 1	337.9	25	100	64973.9
27	H00.6	H	1	0	S	4	3	Plate 1	340.3	24	100	204187.8
82	H10.5	H	0	0	S	3	15	Plate 1	343.3	28	100	320442.7
25	H00.4	H	1	0	S	15	82	Plate 1	346.6	25	100	57772.5
4	C00.4	C	1	0	S	8	25	Plate 1	356.4	24	100	106905.3
23	H00.2	H	1	0	S	6	66	Plate 1	364.5	24	100	145798.9
68	D10.5	D	0	0	S	7	6	Plate 1	366.0	17	100	88879.6
2	C00.2	C	1	0	S	12	9	Plate 1	366.9	26	100	79486.7
22	H00.1	H	1	0	S	11	58	Plate 1	376.5	25	100	85569.1
9	D00.2	D	1	0	S	20	65	Plate 1	389.5	25	100	48682.1
11	D00.4	D	1	0	S	11	81	Plate 1	433.9	26	100	102560.3
28	H00.7	H	1	0	S	11	11	Plate 1	452.5	24	100	98737.7
254	H1.4	H	0	1	S	4	31	Plate 3	12.4	32	100	9942.6
46	G01.4	G	0	1	S	3	52	Plate 1	13.7	25	100	11406.7
256	H2.4	H	1	1	S	1	33	Plate 3	17.3	22	100	37957.7

56	H01.7	H	0	1	S	5	29	Plate 1	19.4	25	100	9679.8
47	G01.5	G	0	1	S	7	60	Plate 1	20.6	25	100	7349.7
241	C1.3	C	0	1	S	3	18	Plate 3	23.7	32	100	25261.8
248	D2.4	D	1	1	S	6	25	Plate 3	26.3	31	100	13471.0
250	G1.4	G	0	1	S	23	27	Plate 3	26.5	28	100	3190.5
50	H01.1	H	0	1	S	7	76	Plate 1	28.0	28	100	11188.5
37	D01.2	D	0	1	S	13	83	Plate 1	30.3	25	100	5823.8
112	H11.7	H	1	1	S	10	7	Plate 2	31.2	33	100	10264.8
51	H01.2	H	0	1	S	22	84	Plate 1	34.5	26	100	4076.9
33	C01.5	C	0	1	S	25	51	Plate 1	36.8	29	100	4267.4
34	C01.6	C	0	1	S	16	59	Plate 1	41.7	24	100	6262.3
39	D01.4	D	0	1	S	9	4	Plate 1	42.5	25	100	11818.1
255	H2.3	H	1	1	S	4	32	Plate 3	43.3	24	100	25950.3
55	H01.6	H	0	1	S	6	21	Plate 1	45.3	25	100	18888.8
49	G01.7	G	0	1	S	25	68	Plate 1	45.9	26	100	4778.4
45	G01.3	G	0	1	S	14	44	Plate 1	46.0	25	100	8212.1
42	D01.7	D	0	1	S	22	28	Plate 1	50.2	26	100	5927.1
36	D01.1	D	0	1	S	14	75	Plate 1	50.8	24	100	8709.3
247	D2.3	D	1	1	S	11	24	Plate 3	53.6	26	100	12675.4
35	C01.7	C	0	1	S	15	67	Plate 1	54.8	24	100	8768.0
41	D01.6	D	0	1	S	5	20	Plate 1	64.1	26	100	33342.3
40	D01.5	D	0	1	S	11	12	Plate 1	64.6	27	100	15861.2
43	G01.1	G	0	1	S	22	36	Plate 1	72.7	25	100	8259.4
245	D1.3	D	0	1	S	2	22	Plate 3	86.0	26	100	113067.6
54	H01.5	H	0	1	S	4	13	Plate 1	90.3	24	100	54168.8
31	C01.3	C	0	1	S	20	35	Plate 1	108.6	25	100	13577.1
249	G1.3	G	0	1	S	7	26	Plate 3	120.0	24	100	40535.5
85	C11.1	C	1	1	S	21	39	Plate 1	121.1	24	100	13835.6
99	G11.1	G	1	1	S	8	48	Plate 1	128.6	27	100	43409.1
29	C01.1	C	0	1	S	8	19	Plate 1	148.3	26	100	48191.6

87	C11.3	C	1	1	S	17	55	Plate 1	162.0	25	100	23826.6
91	C11.7	C	1	1	S	14	87	Plate 1	164.7	27	100	31763.4
97	D11.6	D	1	1	S	14	32	Plate 1	171.6	26	100	31871.4
90	C11.6	C	1	1	S	21	79	Plate 1	197.6	26	100	24463.7
98	D11.7	D	1	1	S	11	40	Plate 1	219.1	27	100	53780.7
104	G11.6	G	1	1	S	13	88	Plate 1	235.7	25	100	45336.4
88	C11.4	C	1	1	S	9	63	Plate 1	236.2	25	100	65616.2
89	C11.5	C	1	1	S	21	71	Plate 1	239.1	25	100	28458.9
96	D11.5	D	1	1	S	16	24	Plate 1	241.2	26	100	39202.7
92	D11.1	D	1	1	S	9	95	Plate 1	259.5	24	100	69208.1
53	H01.4	H	0	1	S	3	5	Plate 1	268.3	25	100	223609.1
101	G11.3	G	1	1	S	12	64	Plate 1	271.4	27	100	61063.7
103	G11.5	G	1	1	S	14	80	Plate 1	275.1	32	100	62889.8
30	C01.2	C	0	1	S	19	27	Plate 1	283.8	23	100	34352.4
94	D11.3	D	1	1	S	13	16	Plate 1	291.6	25	100	56071.2
86	C11.2	C	1	1	S	6	47	Plate 1	300.9	24	100	120360.1
100	G11.2	G	1	1	S	3	56	Plate 1	341.2	28	100	318435.1
32	C01.4	C	0	1	S	9	43	Plate 1	343.0	25	100	95283.8
102	G11.4	G	1	1	S	16	72	Plate 1	375.0	27	100	63284.9
93	D11.2	D	1	1	S	7	8	Plate 1	402.4	25	100	143713.4
108	H11.3	H	1	1	S	6	3	Plate 2	478.3	28	100	220582.3
109	H11.4	H	1	1	S	12	4	Plate 2	509.8	27	100	115875.6
111	H11.6	H	1	1	S	13	6	Plate 2	539.0	28	100	116090.0
110	H11.5	H	1	1	S	11	5	Plate 2	586.8	26	100	140119.2
106	H11.1	H	1	1	S	10	1	Plate 2	684.1	27	100	184700.6
107	H11.2	H	1	1	S	11	2	Plate 2	934.6	29	100	246401.6

Appendix B: Pictures

B.2.1 Microbiology

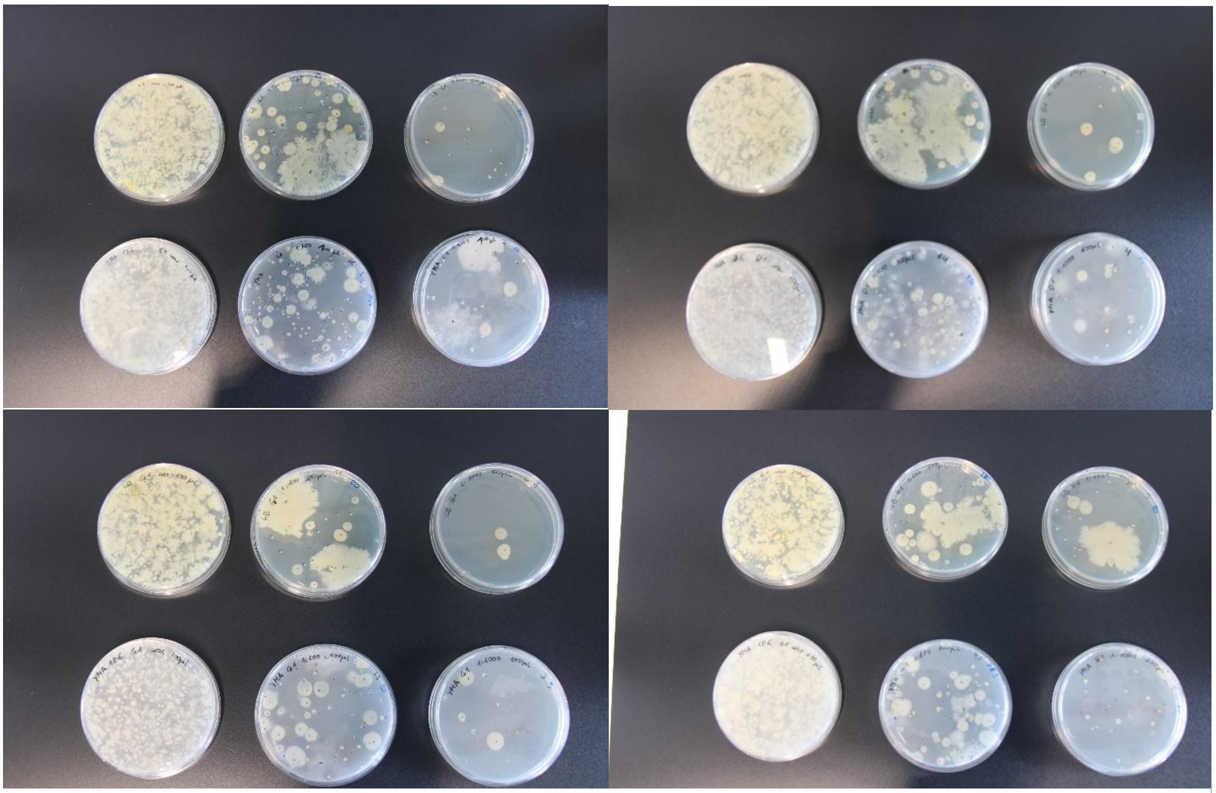

Figure 2: MicroBio 19.06.2024

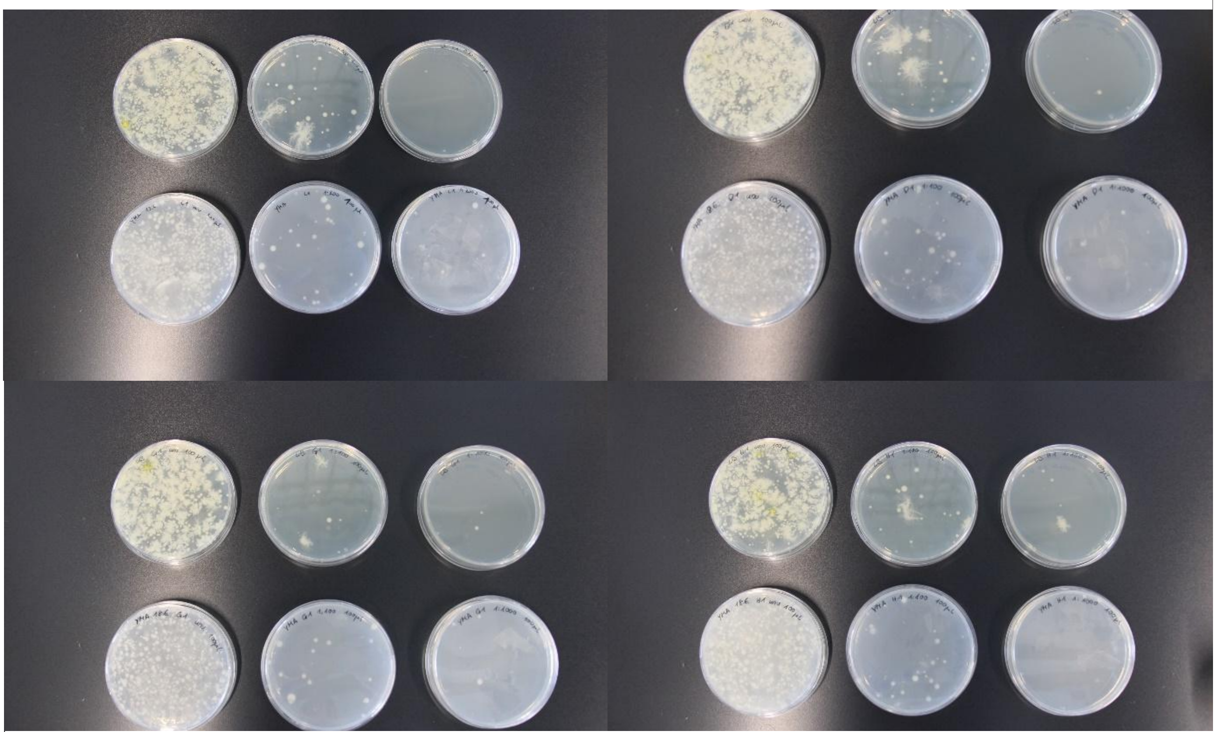

Figure 1: MicroBio 20.06.2024

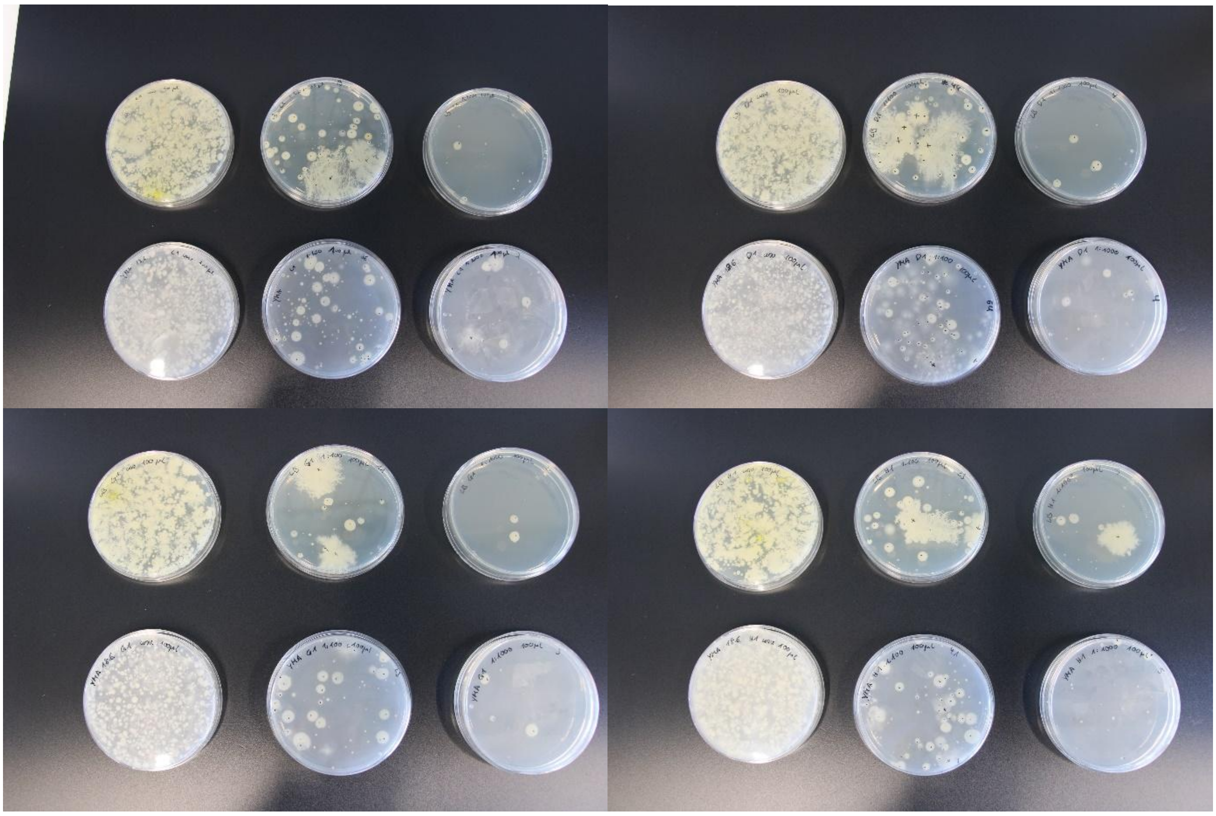

Figure 3: MicroBio 21.06.2024

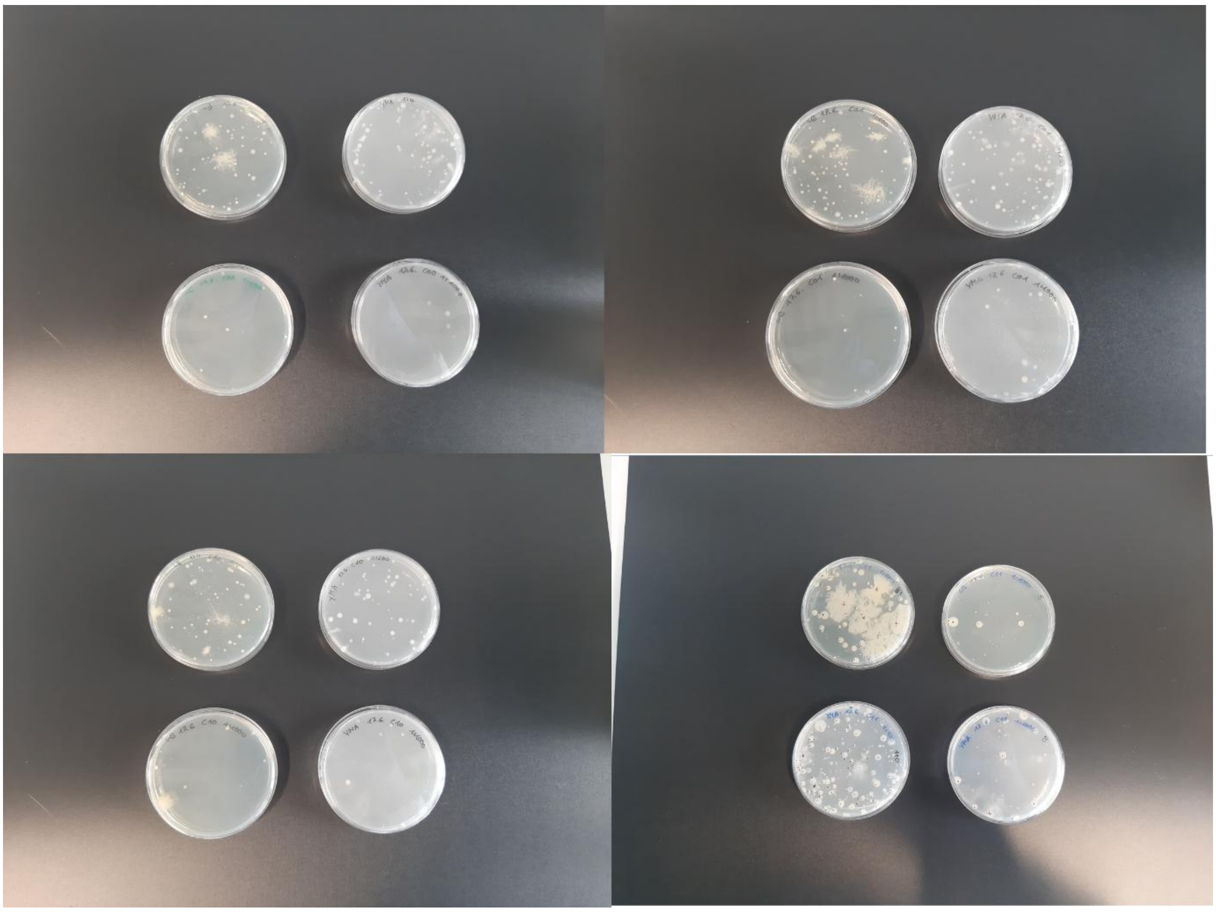

Figure 6: MicroBio 24.07.2024

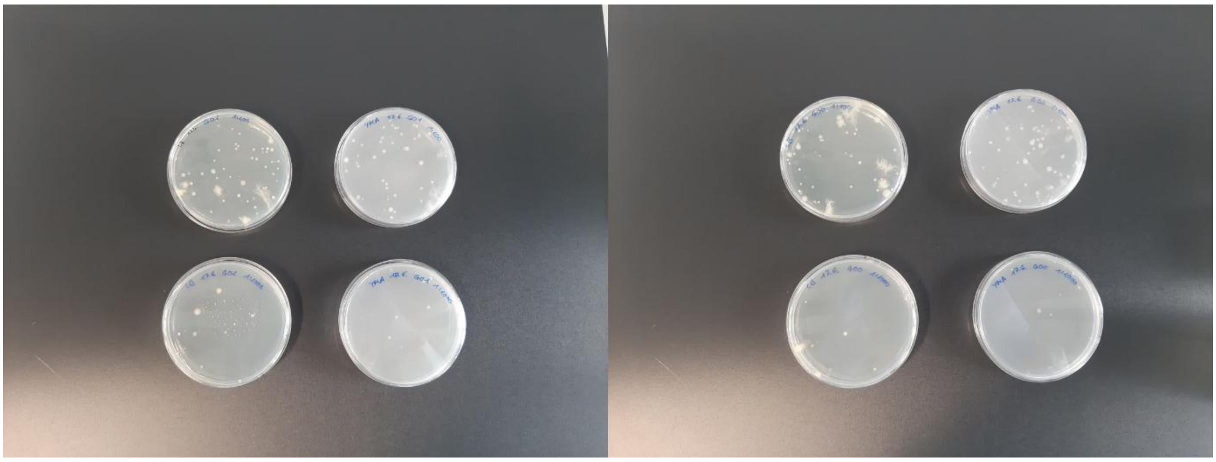

Figure 7: MicroBio 24.07.2024

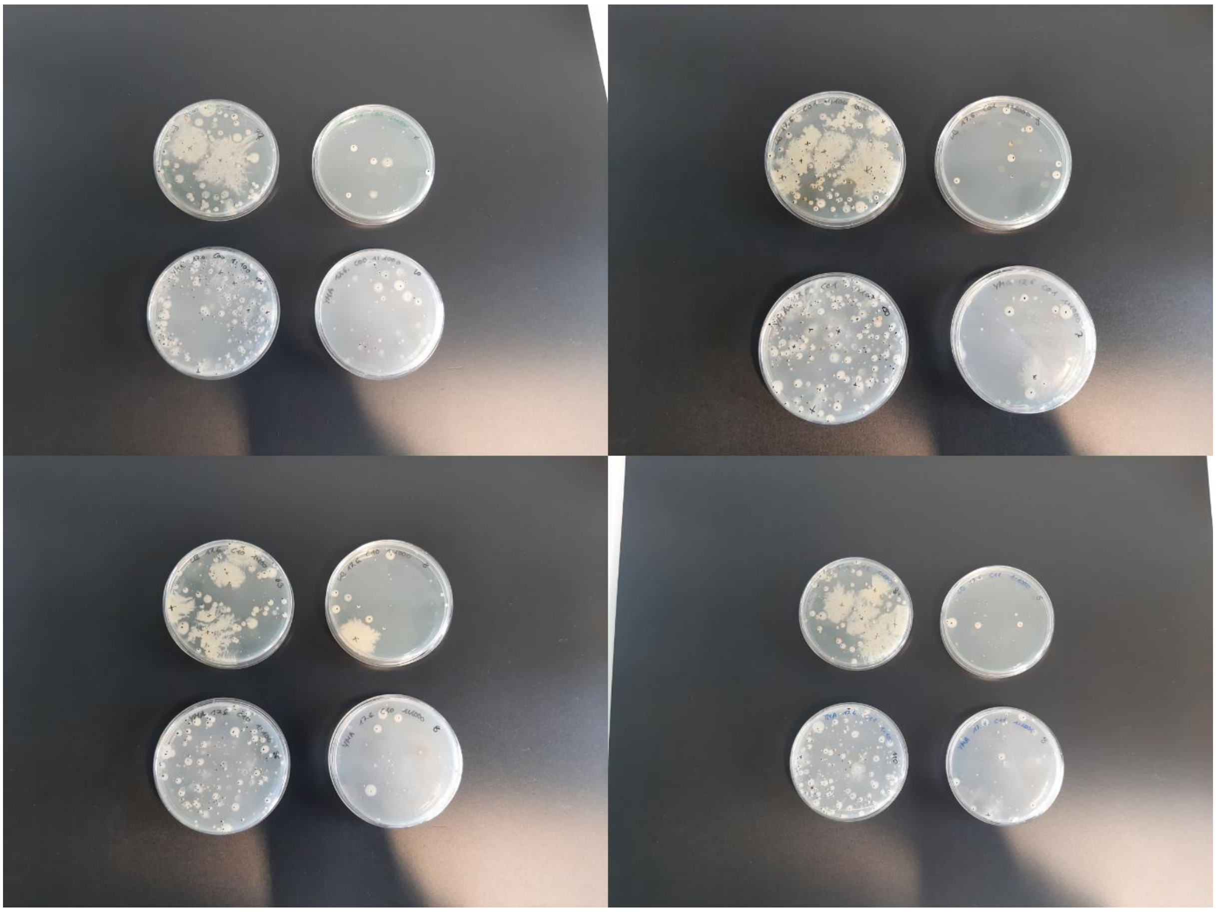

Figure 8: MicroBio 25.07.2024

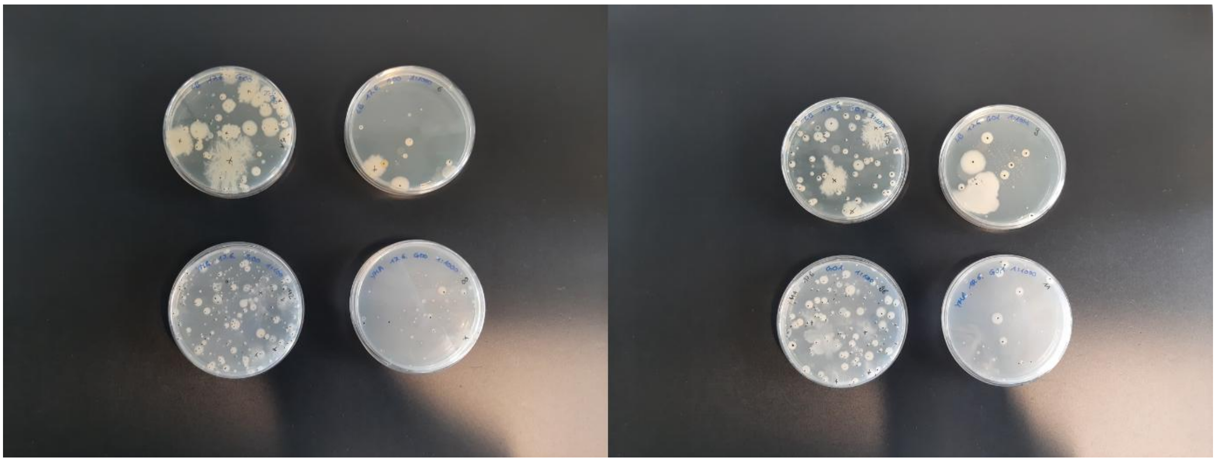

Figure 9: MicroBio 25.07.2024

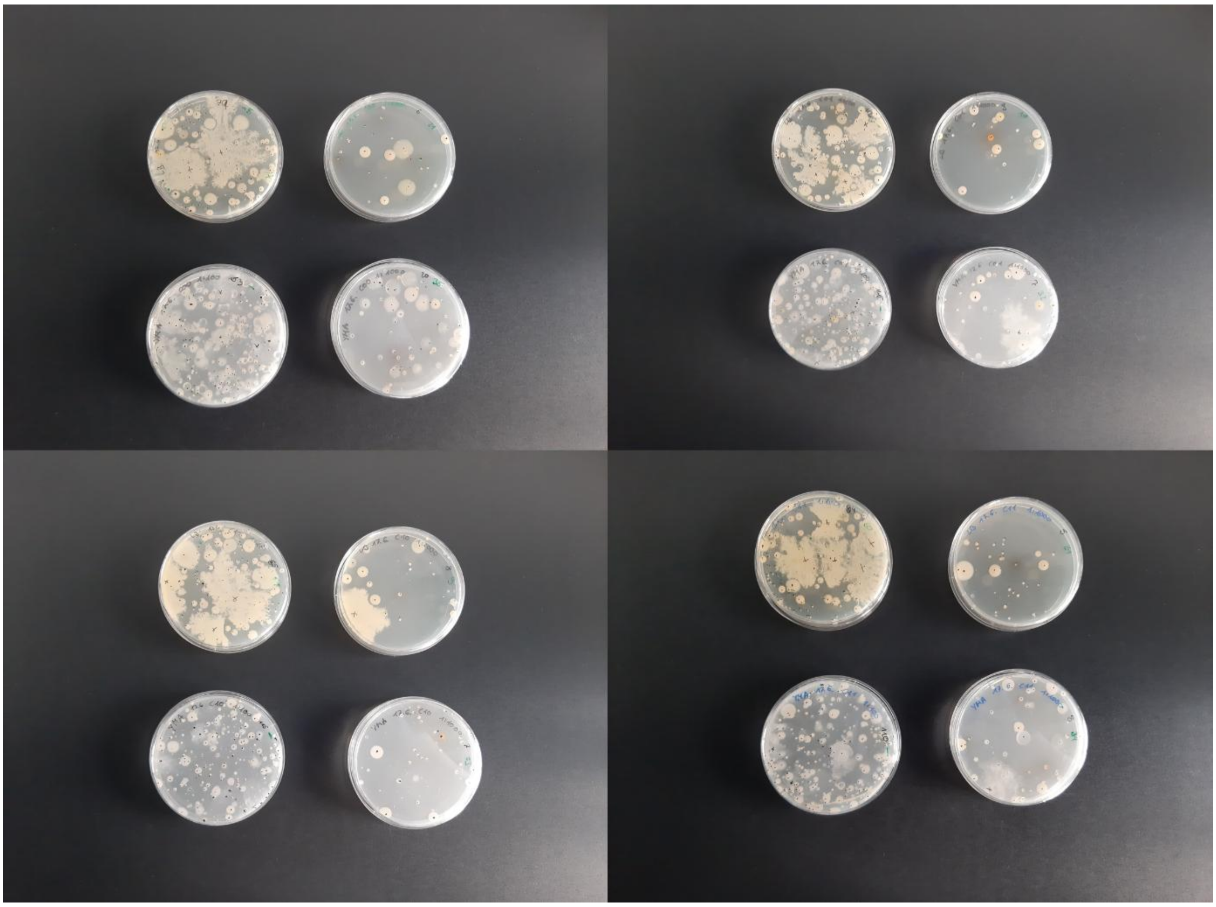

Figure 10: MicroBio 26.07.2024

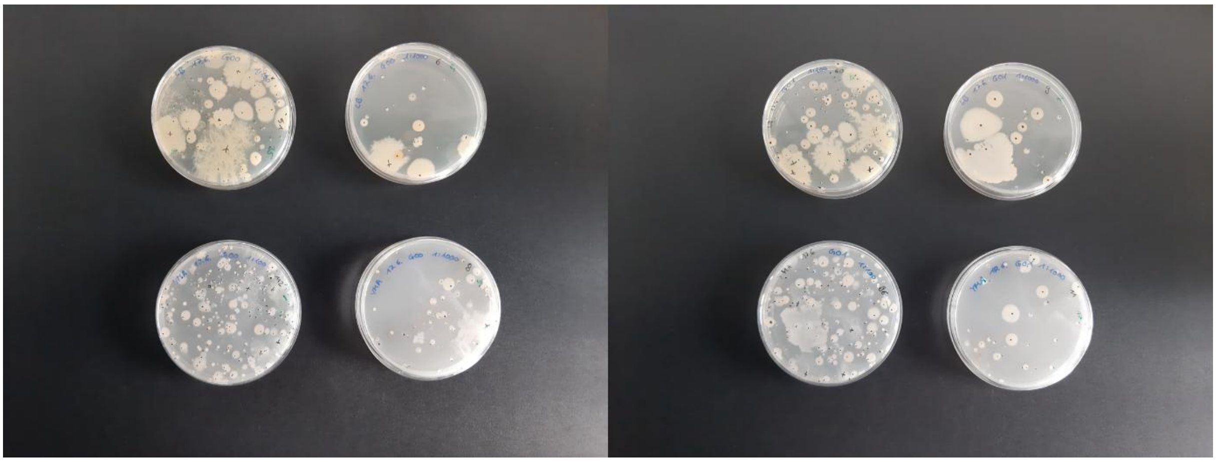

Figure 11: MicroBio 26.07.2024

B.2.2 Plants

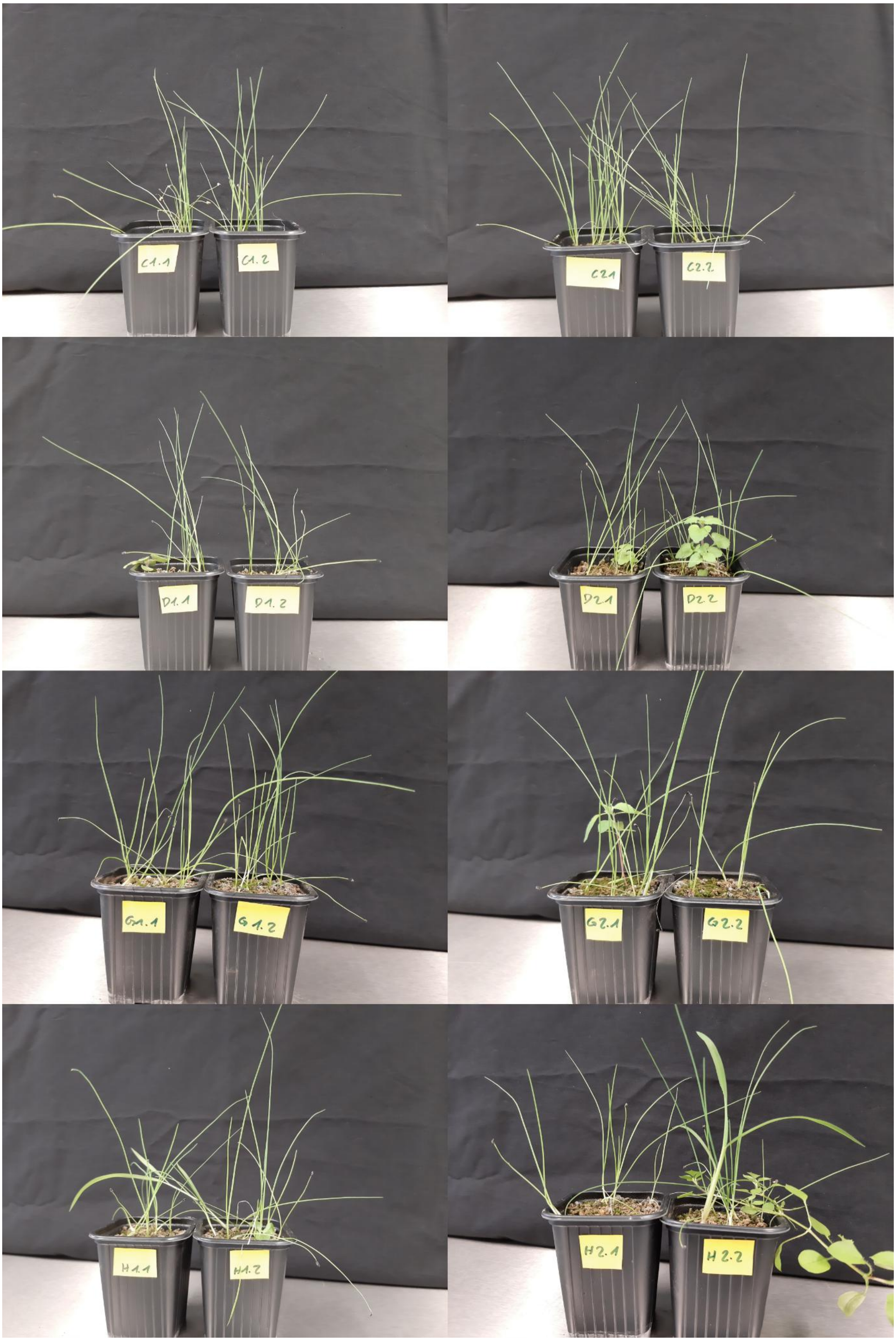

Figure 12: 04.07.2024

Figure 13: 04.07.2024

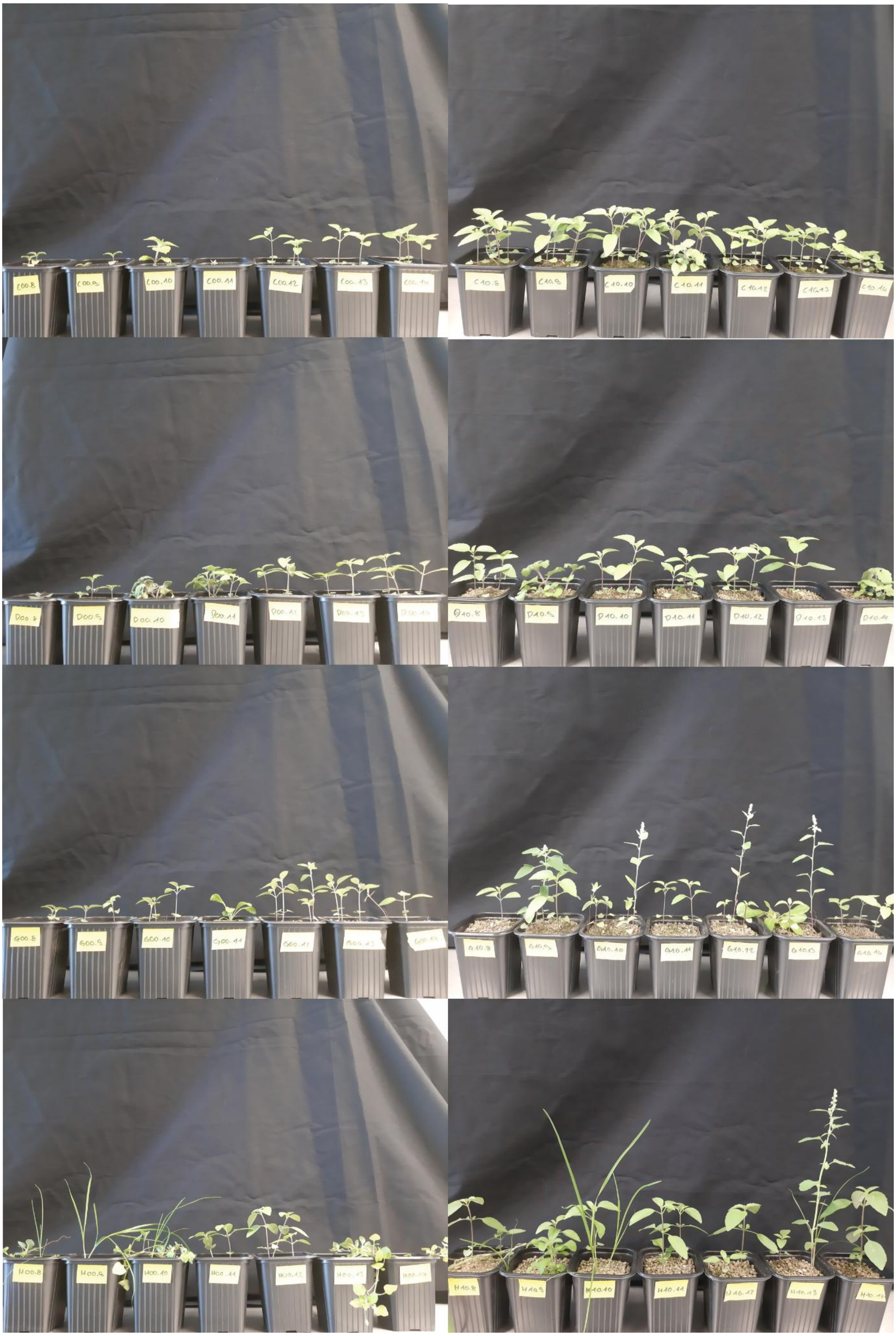

Figure 14: 08.07.2024

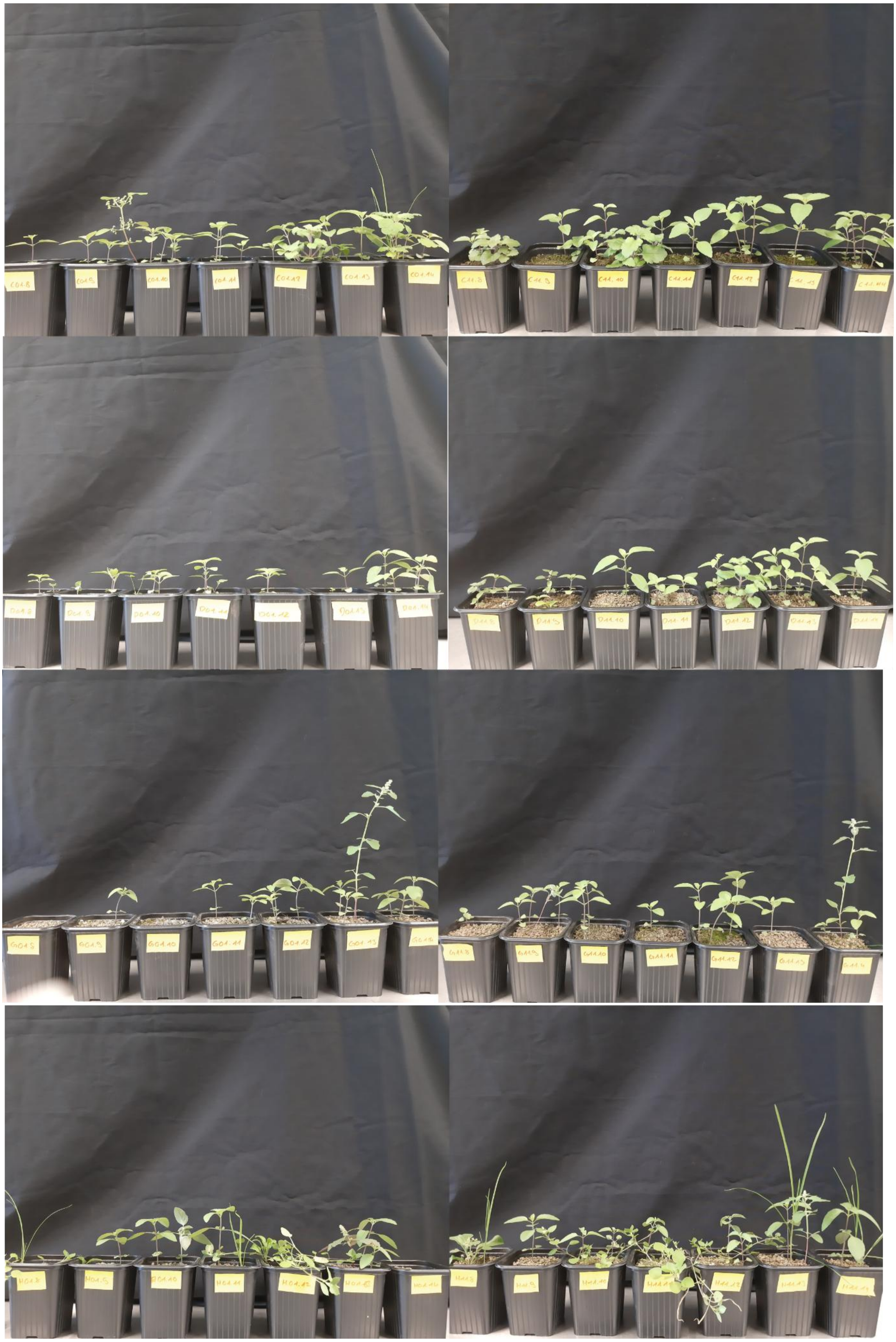

Figure 15: 08.07.2024

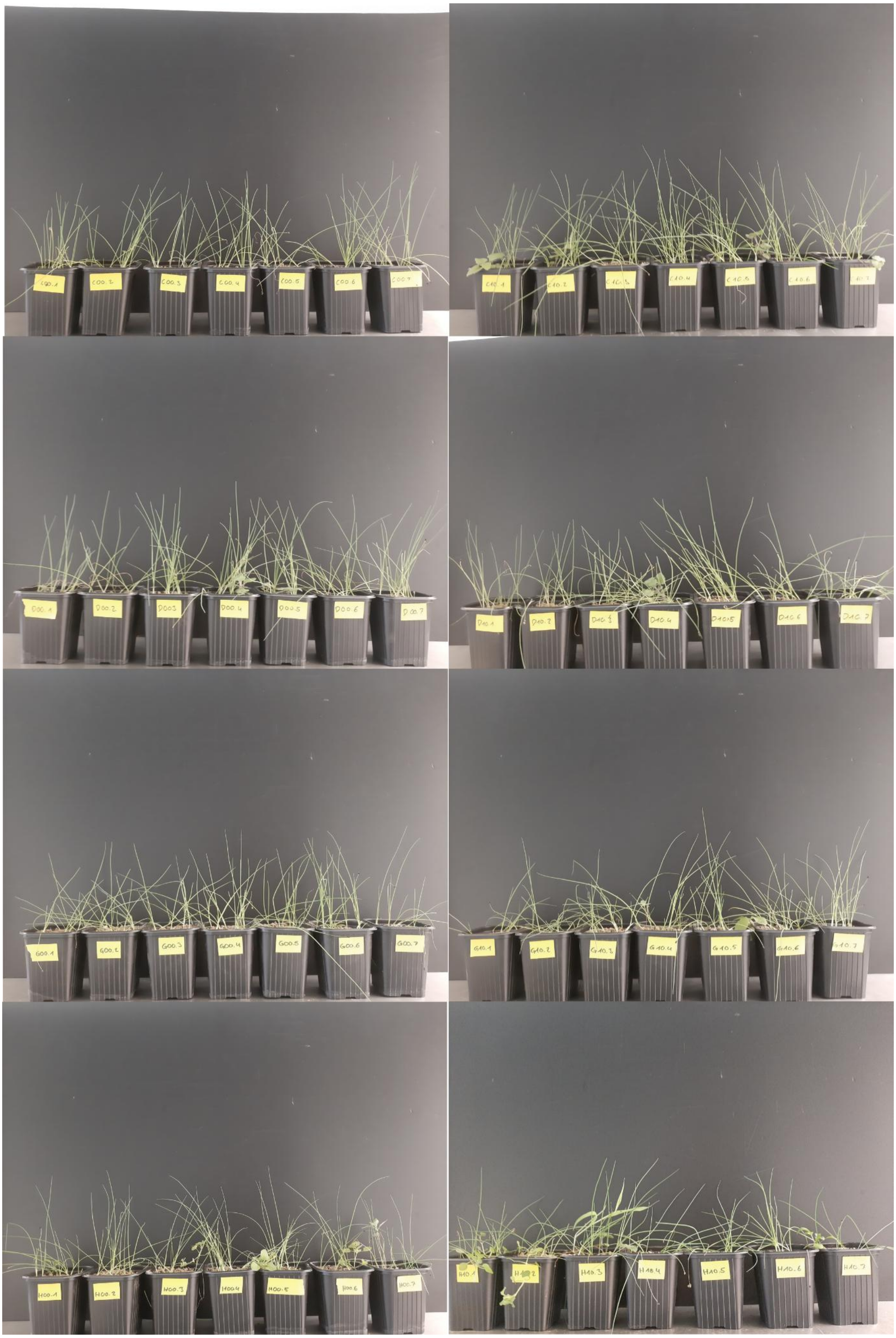

Figure 16: 16.07.2024

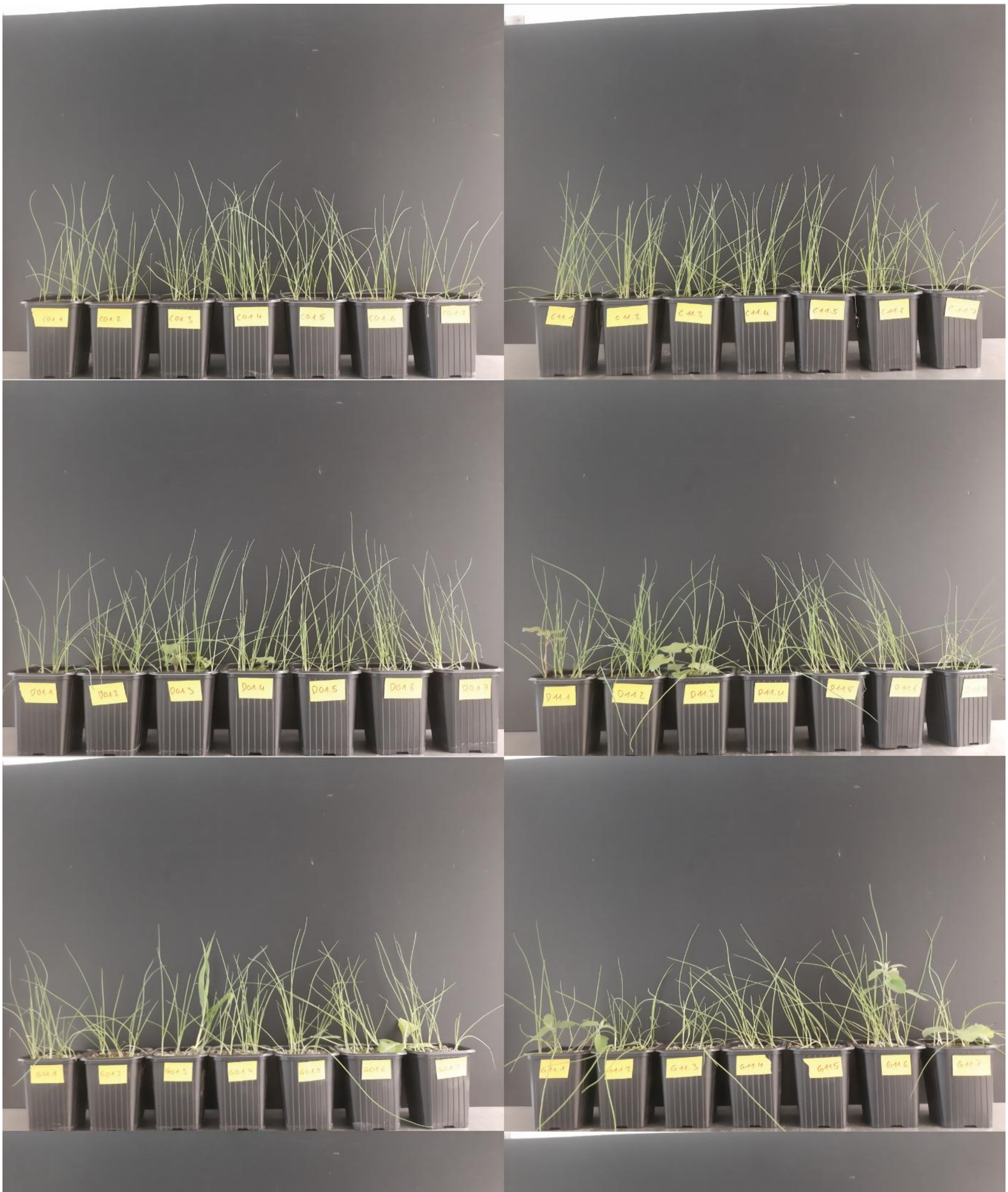

Figure 17: 16.07.2024

Figure 18: 22.07.2024

Figure 19: 22.07.2024

Appendix C: Graphs

C.1.1 Basil

C.1.1.1 Shoot biomass fresh

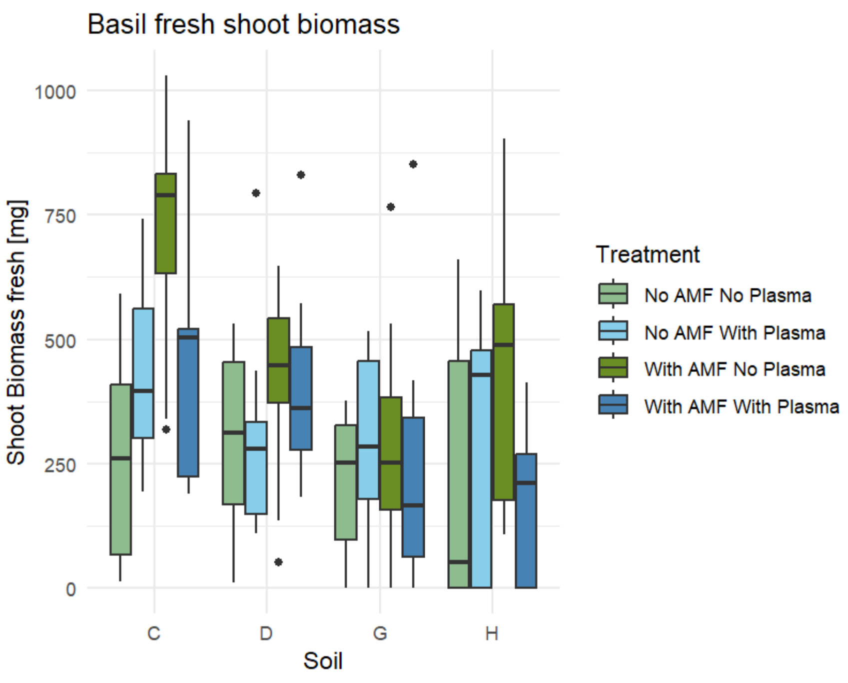

Figure 20: Basil fresh shoot biomass, boxplot

C.1.1.2 Shoot biomass dry

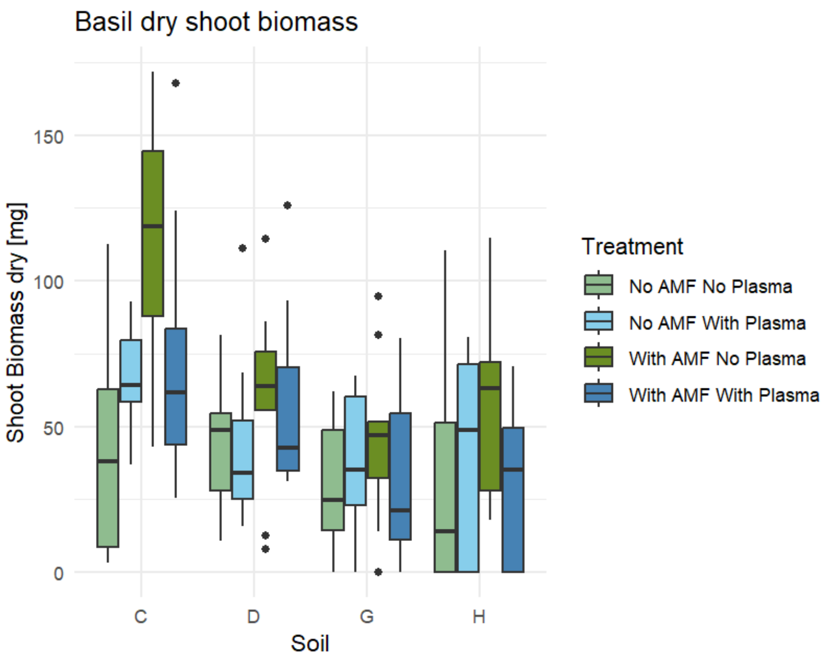

Figure 21: Basil dry shoot biomass, boxplot

C.1.1.3 Root biomass fresh

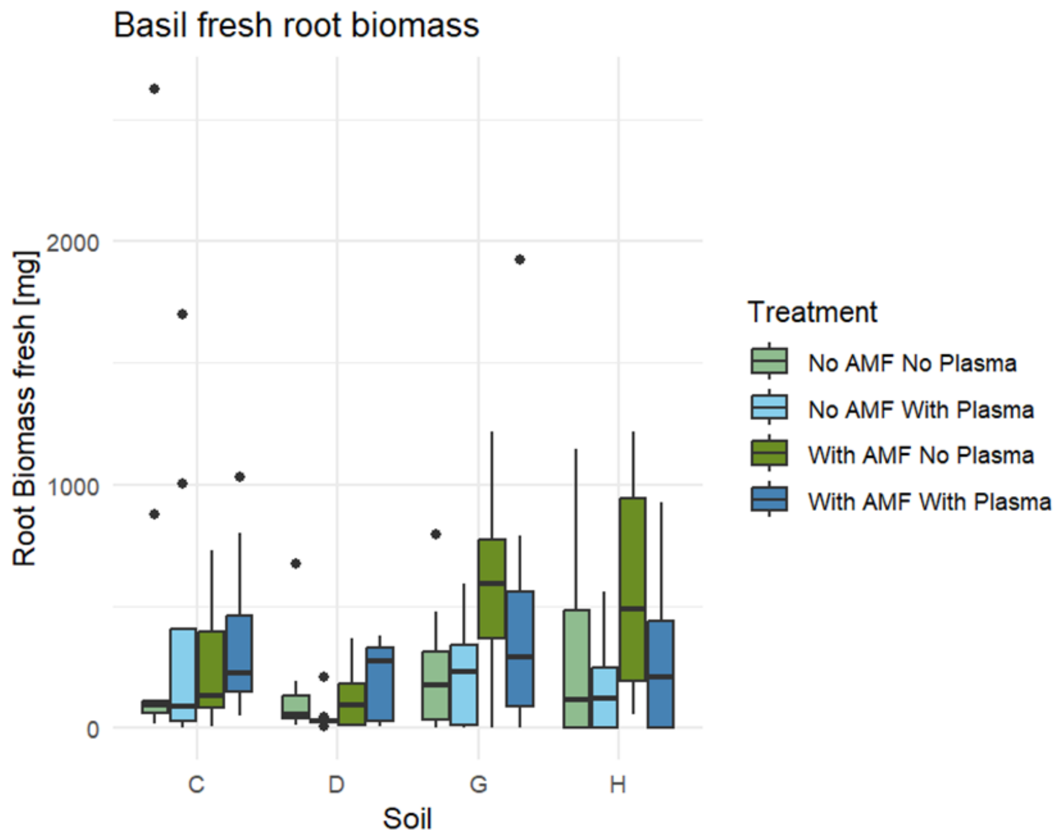

Figure 22: Basil fresh root biomass, boxplot

C.1.1.4 Weeds biomass fresh

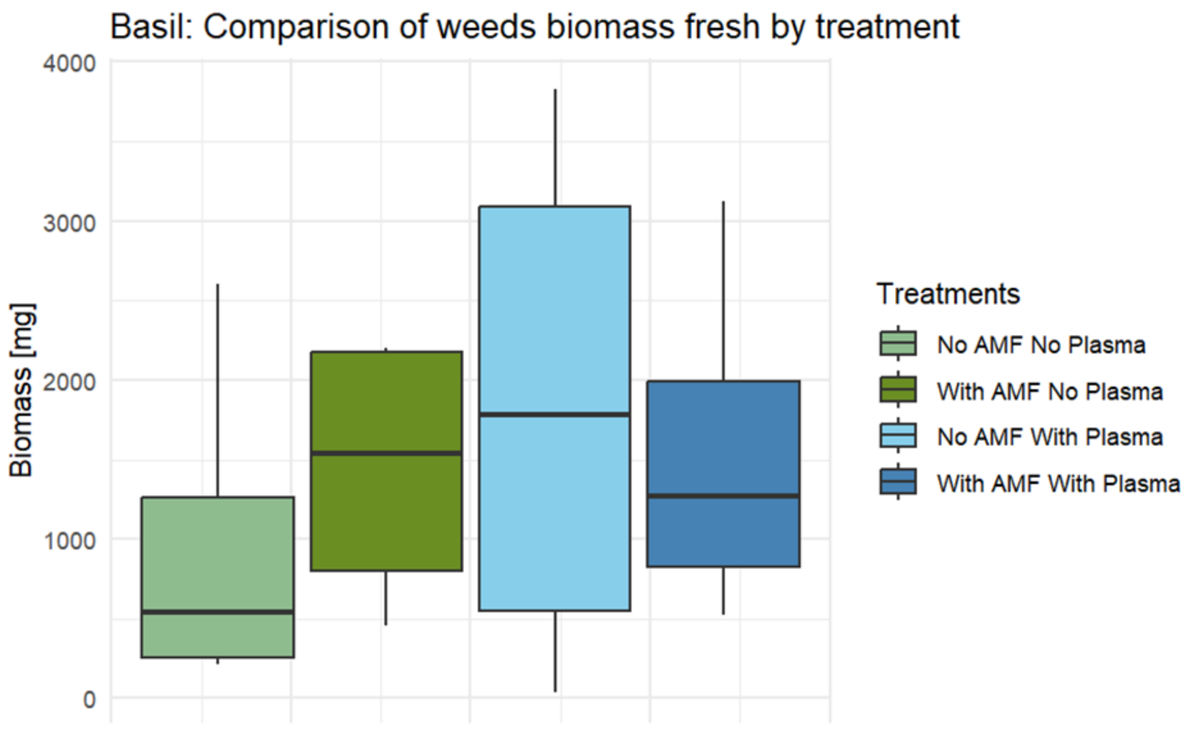

Figure 23: Weeds fresh Biomass, boxplot

C.1.1.5 Weeds biomass dry

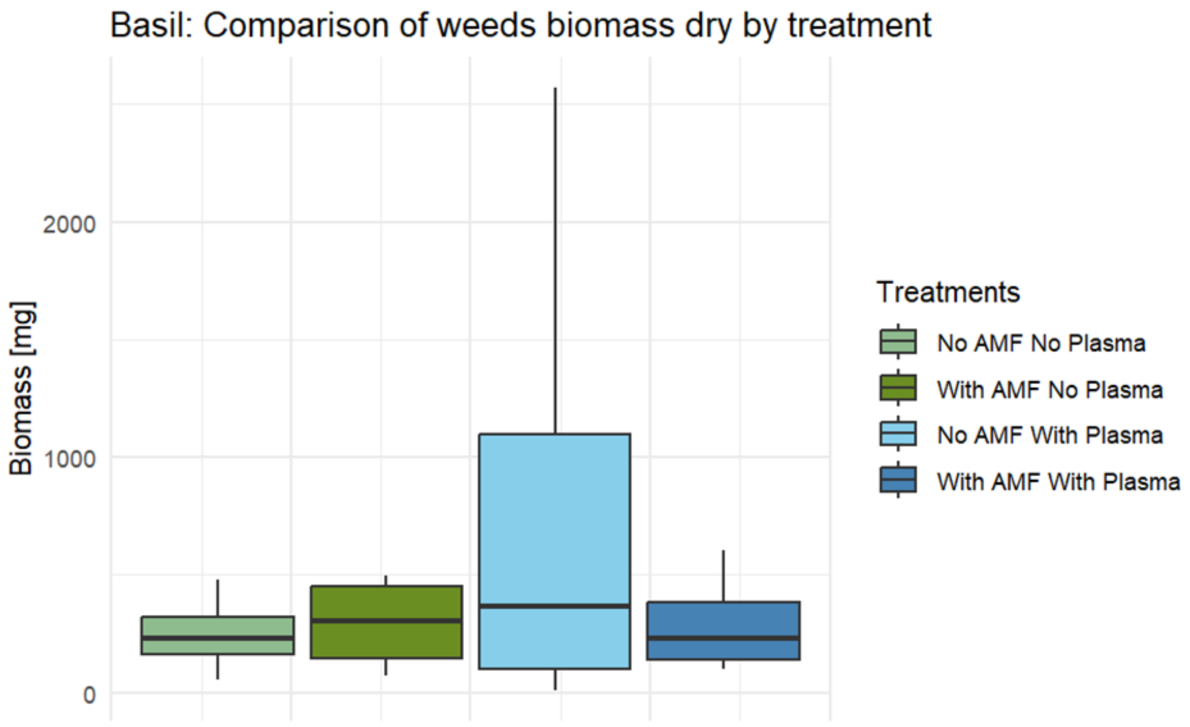

Figure 24: weeds dry biomass, boxplot

C.1.1.6 Mycorrhizal growth response (MGR) fresh and dry

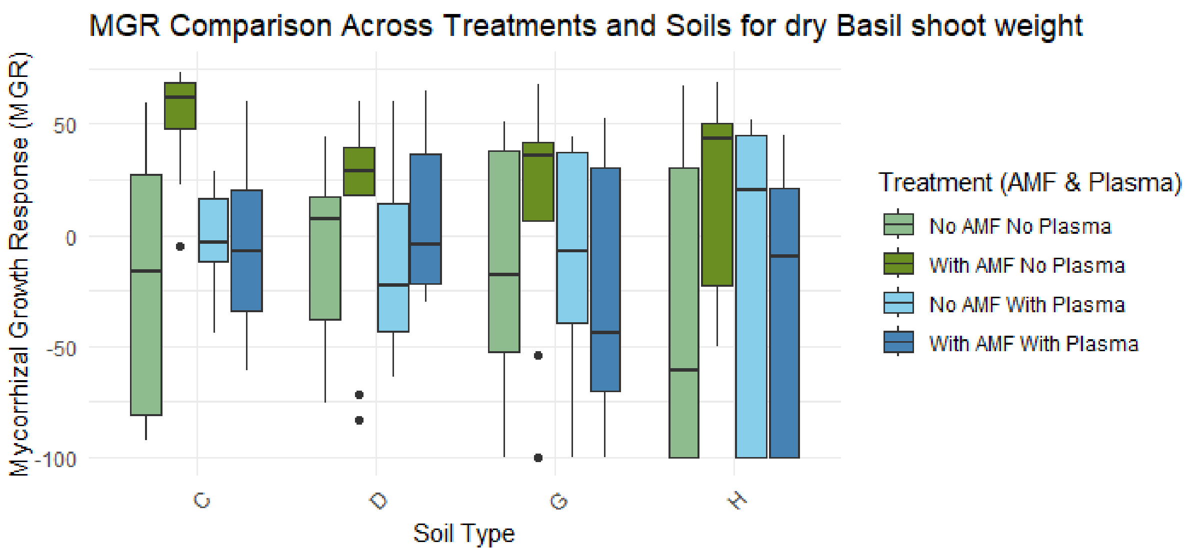

Figure 25: MGR Basil dry, boxplot

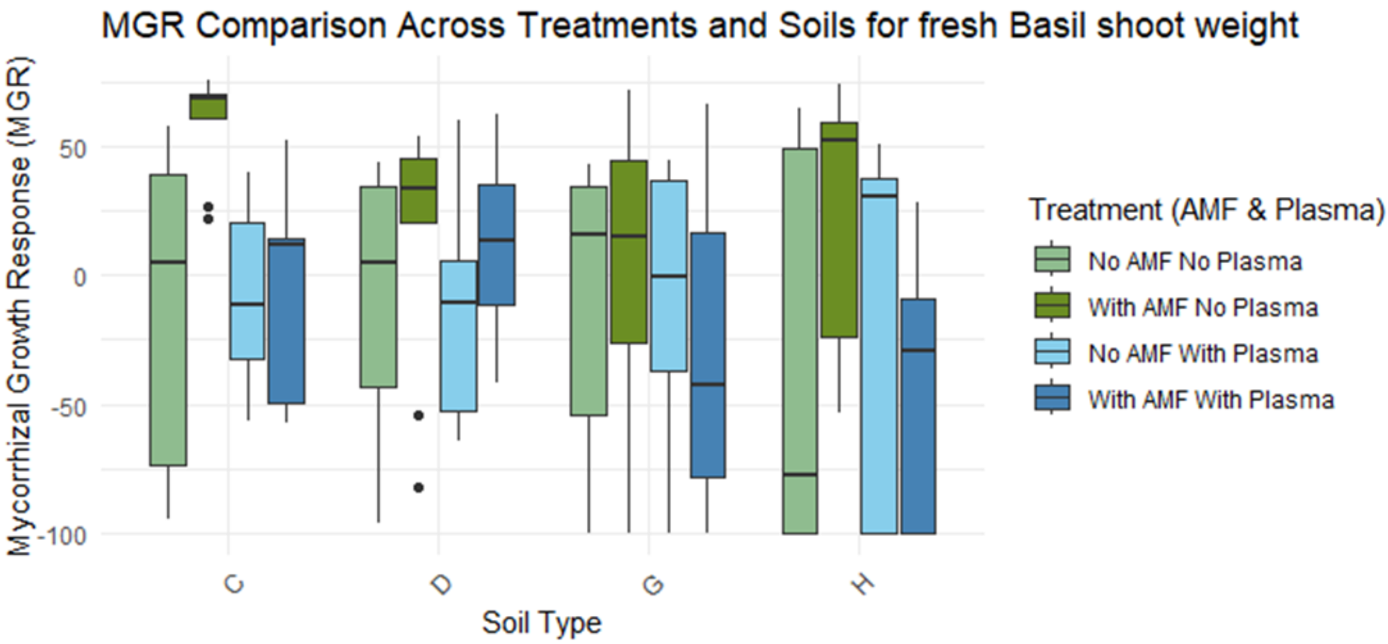

Figure 26: MGR Basil fresh, boxplot

C.1.1.7 Mycorrhizal growth response (MGR) roots

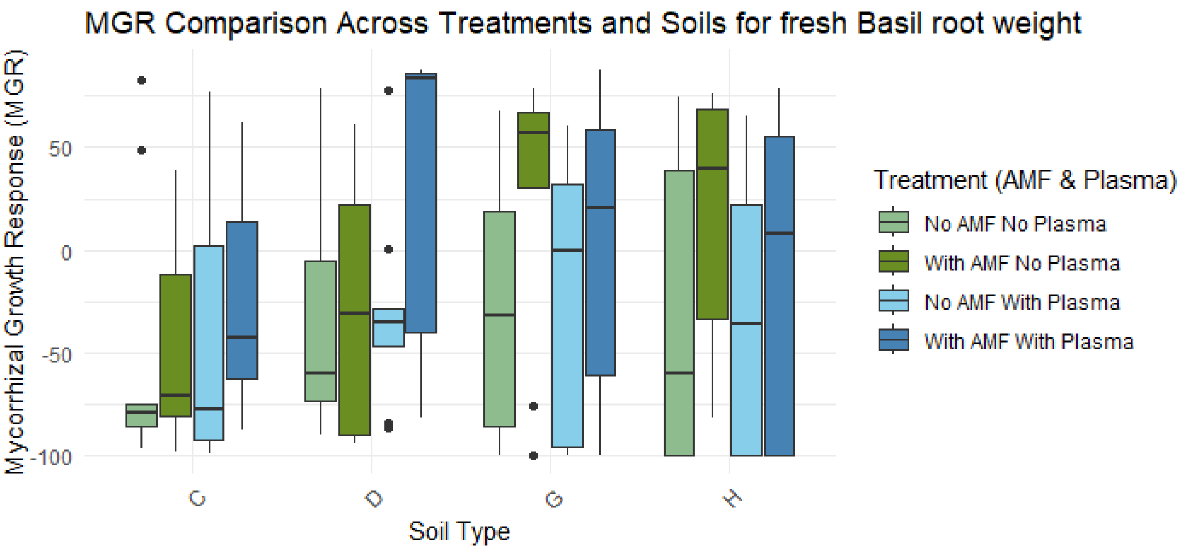

Figure 27: MGR Basil roots, boxplot

C.1.1.8 Root-to-Shoot ratio fresh

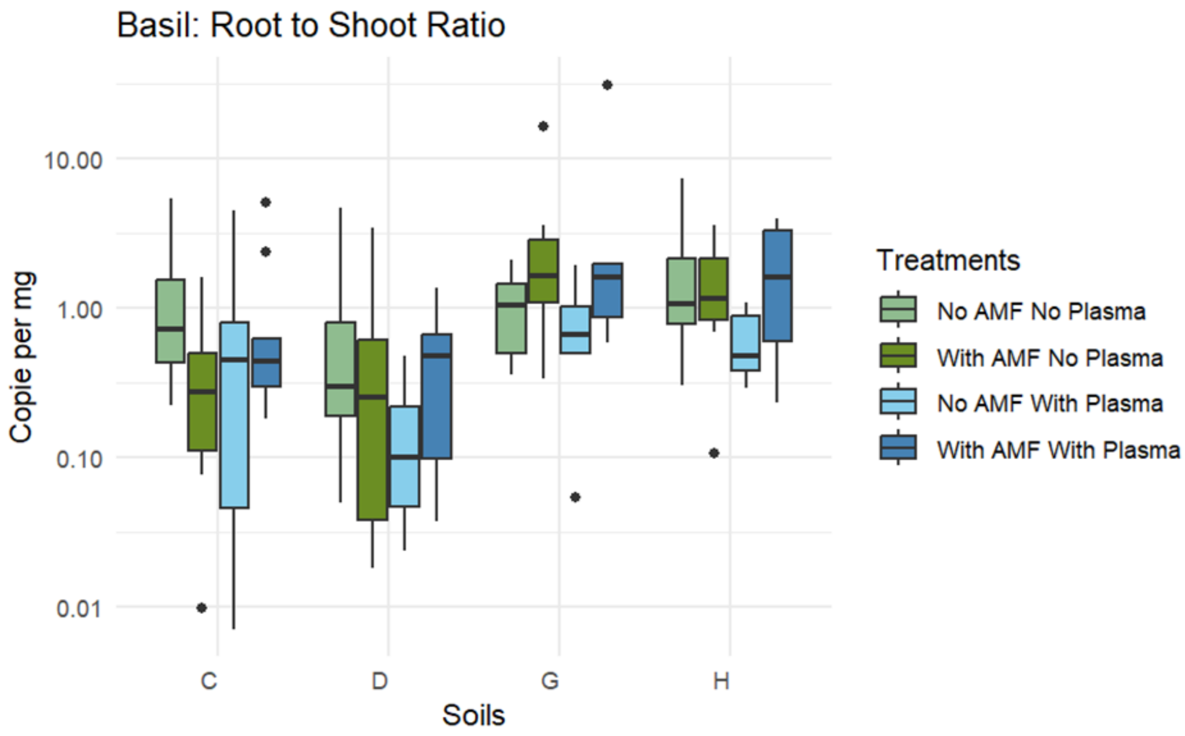

Figure 28: Root to shoot ratio basil, boxplot

C.1.2 Chives

C.1.2.1 Shoot biomass fresh

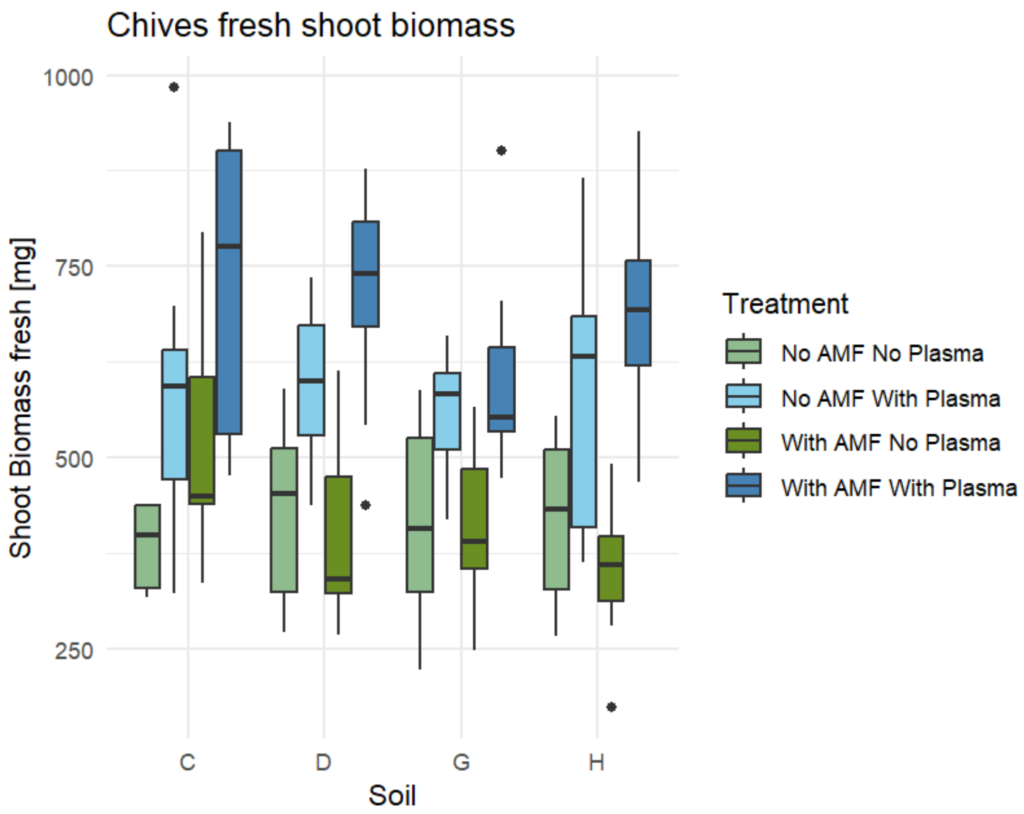

Figure 29: chives biomass fresh, boxplot

C.1.2.2 Shoot biomass dry

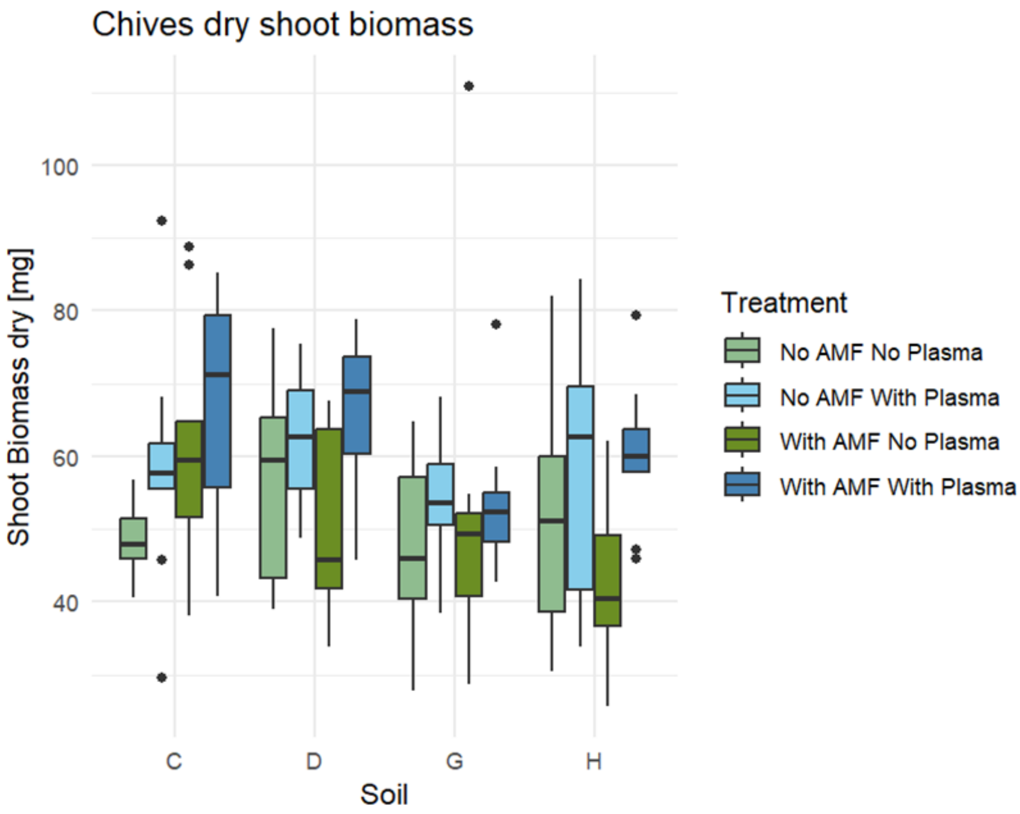

Figure 30: Chives biomass dry, boxplot

C.1.2.3 Root biomass fresh

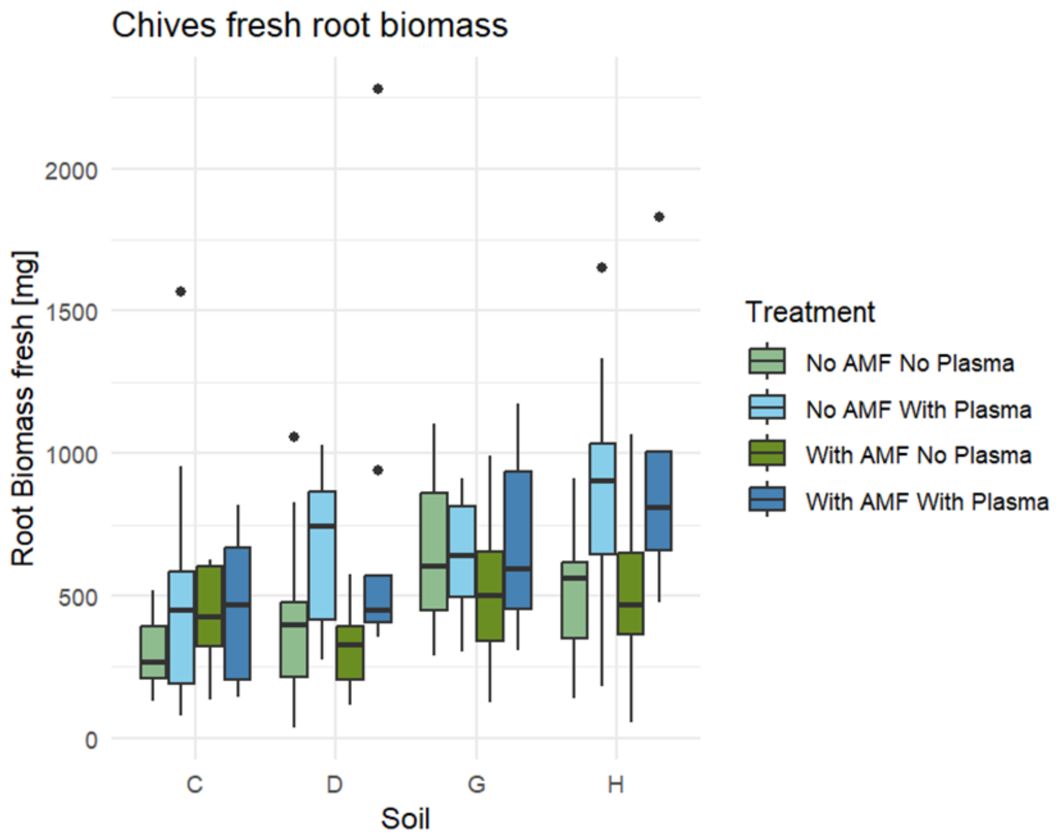

Figure 31: chives root biomass fresh, boxplot

C.1.2.4 Weeds biomass fresh

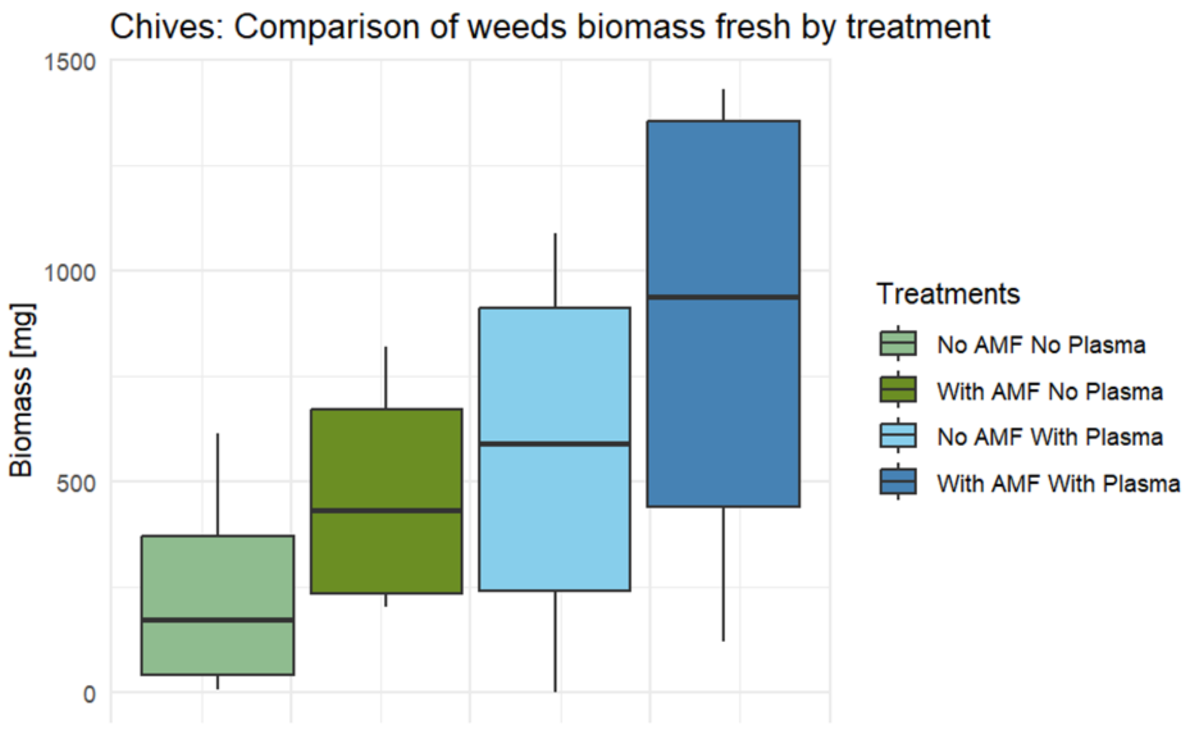

Figure 32: weeds biomass fresh, boxplot

C.1.2.5 Weeds biomass dry

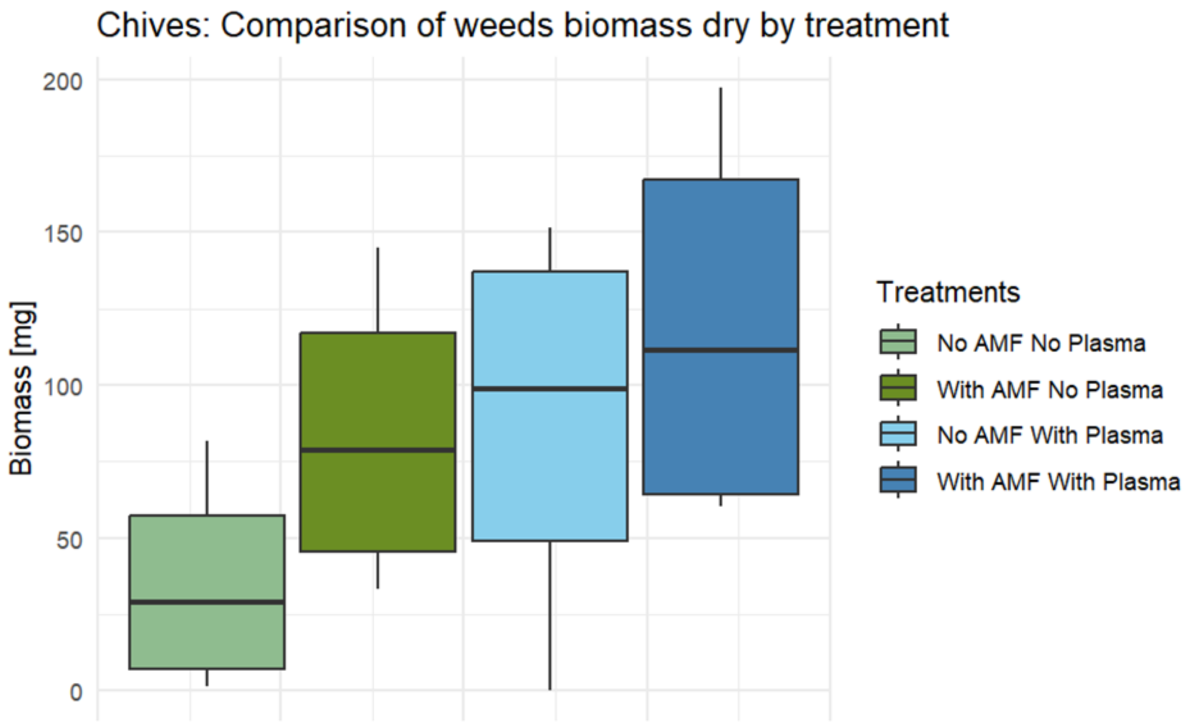

Figure 33: weeds biomass dry, boxplot

C.1.2.6 Mycorrhizal growth response (MGR) fresh and dry

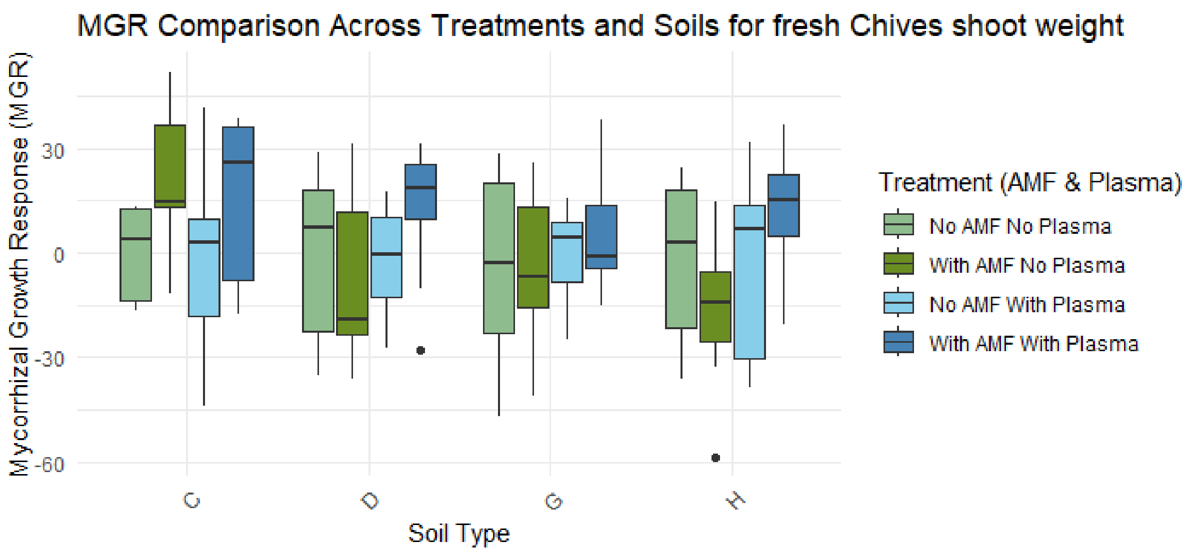

Figure 34: Chives MGR shoot fresh, boxplot

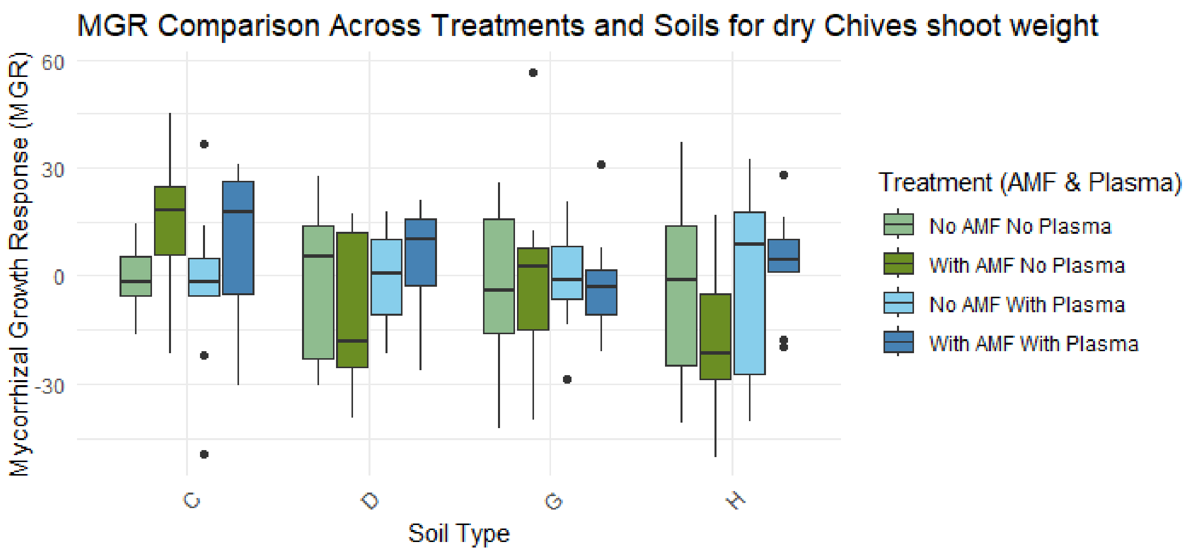

Figure 35: chives MGR shoot dry, boxplot

C.1.2.7 Mycorrhizal growth response (MGR) roots

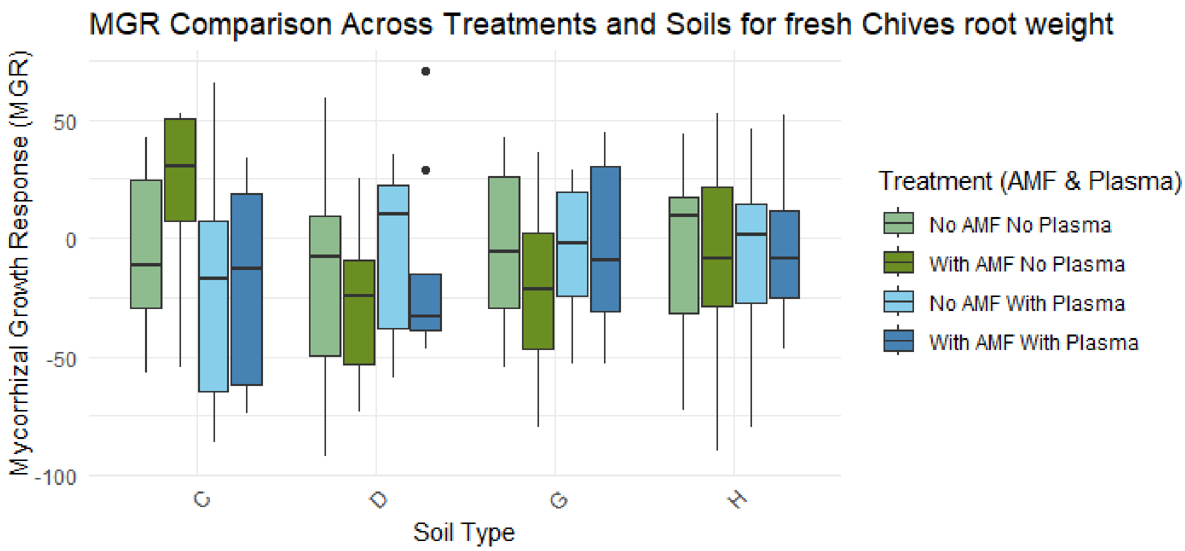

Figure 36: Chives MGR root fresh, boxplot

C.1.2.8 Root-to-Shoot ratio fresh

Figure 37: chives root to shoot ratio, boxplot

C.2. DNA Extraction and qPCR Analysis

C.2.1 Basil

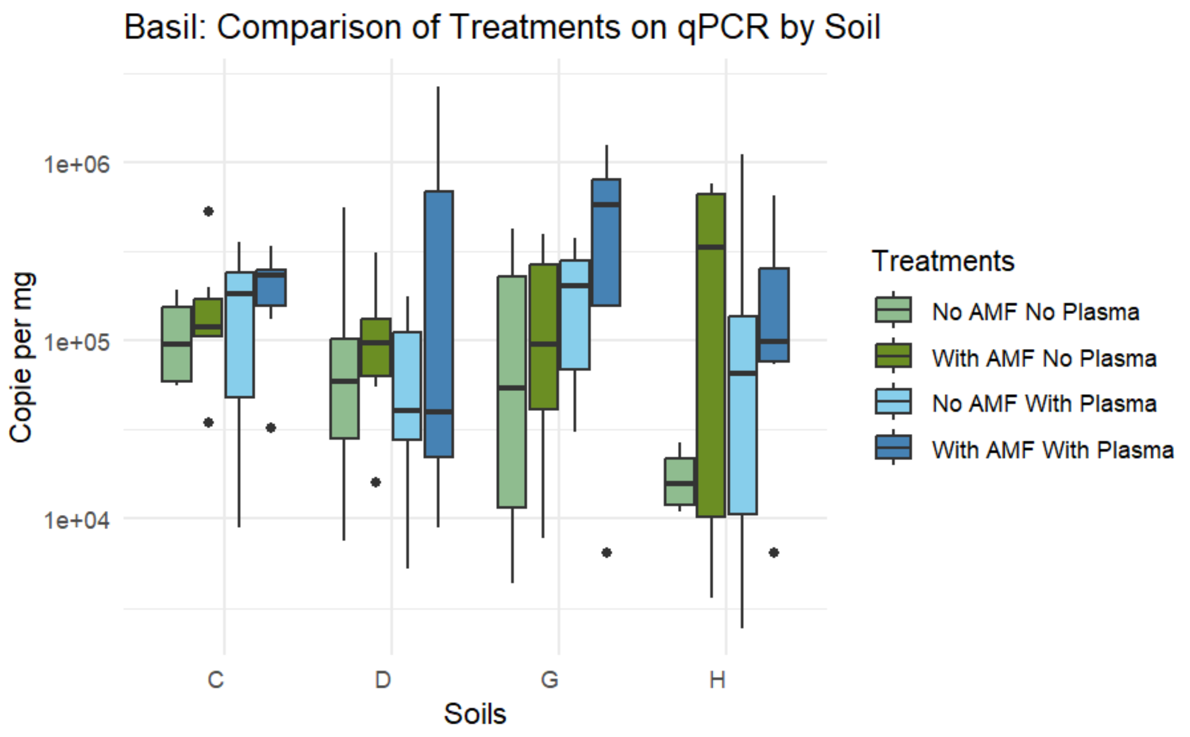

Figure 38:Basil qPCR, boxplot

C.2.2 Chives

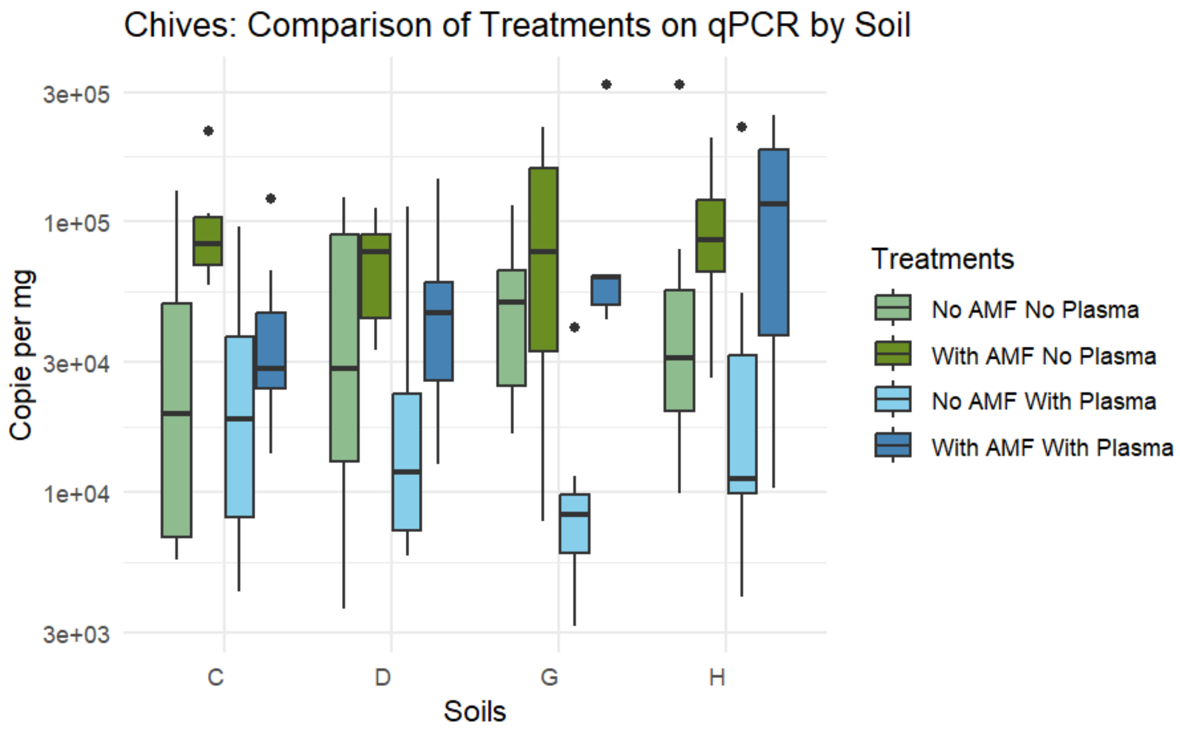

Figure 39: Chives qPCR, boxplot

C.3 Microbiological analysis

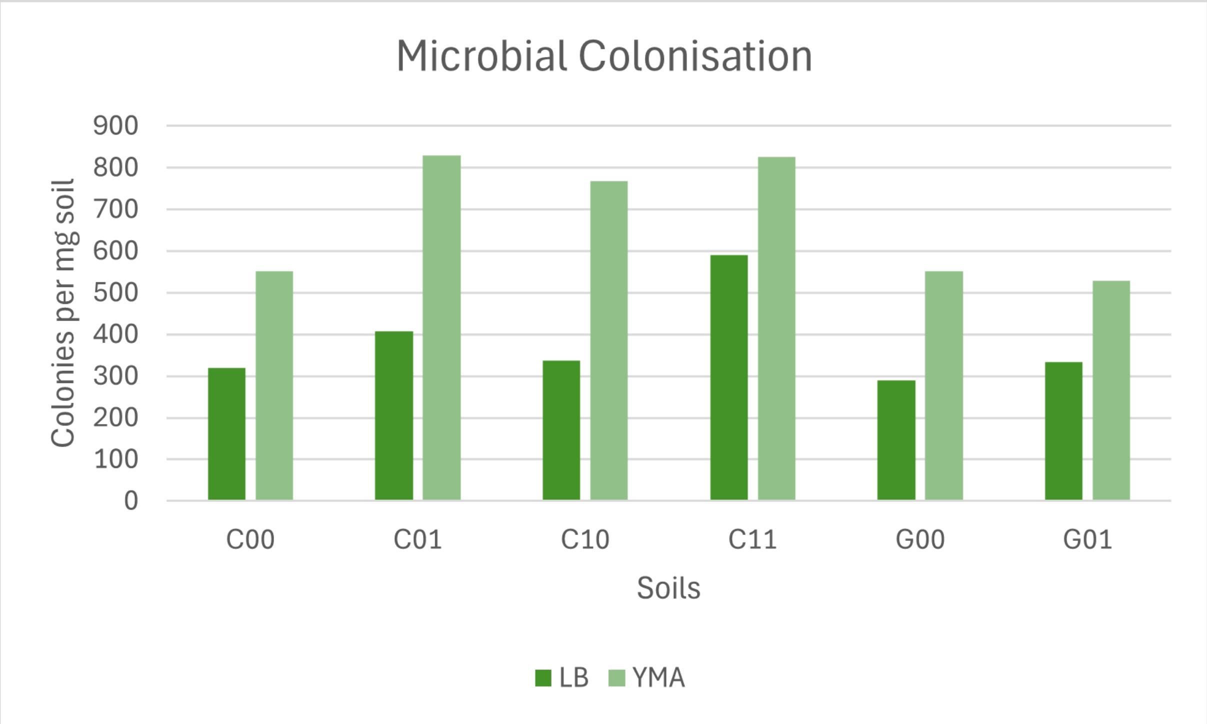

Figure 40: Microbial analysis, colonies per mg soil

Appendix D: ANOVA Tables

D.1 Basil

D.1.1 Shoot biomass fresh

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Erde	3	903301	301100	6.036	0.000706	***
AMF	1	345176	345176	6.920	0.009571	**
Plasma	1	19219	19219	0.385	0.535888	
Erde:AMF	3	252061	84020	1.684	0.173625	
Erde:Plasma	3	68981	22994	0.461	0.710038	
AMF:Plasma	1	444200	444200	8.905	0.003407	**
Erde:AMF:Plasma	3	215752	71917	1.442	0.233720	
Residuals	128	6384920	49882			

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

D.1.2 Shoot biomass dry

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Erde	3	30488	10163	9.269	1.36e-05	***
AMF	1	9863	9863	8.996	0.00325	**
Plasma	1	1121	1121	1.023	0.31376	
Erde:AMF	3	5647	1882	1.717	0.16681	
Erde:Plasma	3	795	265	0.242	0.86716	
AMF:Plasma	1	6290	6290	5.737	0.01806	*
Erde:AMF:Plasma	3	4146	1382	1.261	0.29080	
Residuals	128	140342	1096			

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

D.1.3 Root biomass fresh

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Erde	3	1503162	501054	3.222	0.0249	*
AMF	1	420639	420639	2.705	0.1025	
Plasma	1	108351	108351	0.697	0.4054	
Erde:AMF	3	794264	264755	1.703	0.1698	
Erde:Plasma	3	228096	76032	0.489	0.6906	
AMF:Plasma	1	5763	5763	0.037	0.8476	
Erde:AMF:Plasma	3	187848	62616	0.403	0.7513	
Residuals	128	19904789	155506			

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

D.2 Chives

D.2.1 Shoot biomass fresh

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Erde	3	63856	21285	1.205	0.31069	
AMF	1	126268	126268	7.148	0.00848	**
Plasma	1	1677306	1677306	94.956	< 2e-16	***
Erde:AMF	3	102863	34288	1.941	0.12623	
Erde:Plasma	3	46293	15431	0.874	0.45672	
AMF:Plasma	1	71650	71650	4.056	0.04610	*
Erde:AMF:Plasma	3	36141	12047	0.682	0.56461	
Residuals	128	2260995	17664			

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

D.2.2 Shoot biomass dry

```
Df Sum Sq Mean Sq F value   Pr(>F)
Erde                3    1395    465.0   2.366 0.074007 .
AMF                 1     193    193.0   0.982 0.323587
Plasma              1    2705   2704.9  13.763 0.000308 ***
Erde:AMF            3     934    311.4   1.585 0.196290
Erde:Plasma         3     291     97.1   0.494 0.686994
AMF:Plasma          1     113    113.2   0.576 0.449187
Erde:AMF:Plasma     3     474    157.9   0.803 0.494156
Residuals         128   25155    196.5
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

D.2.3 Root biomass fresh

```
Df    Sum Sq Mean Sq F value    Pr(>F)
Erde                3   1316705  438902   4.097   0.00817 **
AMF                 1     12466   12466   0.116   0.73357
Plasma              1   1871880 1871880  17.474 5.36e-05 ***
Erde:AMF            3     52303   17434   0.163   0.92126
Erde:Plasma         3    537485  179162   1.672   0.17620
AMF:Plasma          1      3634    3634   0.034   0.85416
Erde:AMF:Plasma     3    170673   56891   0.531   0.66176
Residuals         128  13711925  107124
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

D.3. DNA Extraction and qPCR Analysis

D.3.1 Basil

```
                Df    Sum Sq   Mean Sq F value Pr(>F)
Erde             3 1.398e+11 4.659e+10   0.371 0.7744
AMF              1 5.920e+11 5.920e+11   4.710 0.0327 *
Plasma           1 4.537e+11 4.537e+11   3.609 0.0607 .
Erde:AMF         3 1.753e+11 5.843e+10   0.465 0.7076
Erde:Plasma      3 3.321e+11 1.107e+11   0.881 0.4544
AMF:Plasma       1 1.565e+11 1.565e+11   1.245 0.2676
Erde:AMF:Plasma  3 7.788e+11 2.596e+11   2.065 0.1106
Residuals       88 1.106e+13 1.257e+11
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

D.3.2 Chives

```
                Df    Sum Sq   Mean Sq F value   Pr(>F)
Erde             3 2.408e+10 8.025e+09   2.061 0.110379
AMF              1 5.581e+10 5.581e+10  14.330 0.000264 ***
Plasma           1 9.392e+09 9.392e+09   2.412 0.123663
Erde:AMF         3 8.500e+09 2.833e+09   0.728 0.537971
Erde:Plasma      3 4.652e+09 1.551e+09   0.398 0.754620
AMF:Plasma       1 9.974e+08 9.974e+08   0.256 0.613940
Erde:AMF:Plasma  3 9.057e+09 3.019e+09   0.775 0.510559
Residuals       98 3.816e+11 3.894e+09
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

D.4 Plant interaction

```
Df  Sum Sq Mean Sq F value   Pr(>F)
Pflanze                     1 2469475 2469475  73.120 1.13e-15 ***
Erde                        3  716540  238847   7.072 0.000139 ***
AMF                         1  444491  444491  13.161 0.000345 ***
Plasma                      1  668717  668717  19.800 1.28e-05 ***
Pflanze:Erde                3  250616   83539   2.474 0.062110 .
Pflanze:AMF                 1   26953   26953   0.798 0.372516
Erde:AMF                    3  336450  112150   3.321 0.020419 *
Pflanze:Plasma              1 1027808 1027808  30.433 8.45e-08 ***
Erde:Plasma                 3   23354    7785   0.230 0.875106
AMF:Plasma                  1   79524   79524   2.355 0.126144
Pflanze:Erde:AMF            3   18474    6158   0.182 0.908340
Pflanze:Erde:Plasma         3   91920   30640   0.907 0.438088
Pflanze:AMF:Plasma          1  436326  436326  12.919 0.000390 ***
Erde:AMF:Plasma             3  157224   52408   1.552 0.201623
Pflanze:Erde:AMF:Plasma     3   94669   31556   0.934 0.424609
Residuals                 256 8645915   33773
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

D.5 Tukey Wilkox Test

Basil fresh:

Post-hoc test:

```
Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = Gewicht_frisch ~ Erde * AMF * Plasma, data = d)

$Erde
          diff       lwr       upr     p adj
D-C -112.26111 -249.2949  24.77272 0.1483999
G-C -206.07222 -343.1061 -69.03839 0.0008349
H-C -177.31111 -314.3449 -40.27728 0.0054576
G-D  -93.81111 -230.8449  43.22272 0.2866993
H-D  -65.05000 -202.0838  71.98383 0.6054056
H-G   28.76111 -108.2727 165.79494 0.9473795

$AMF
        diff      lwr      upr     p adj
1-0 97.91944 24.26566 171.5732 0.0095707

$Plasma
          diff       lwr      upr     p adj
1-0 -23.10556 -96.75934 50.54823 0.5358883

$`Erde:AMF`
               diff         lwr       upr     p adj
D:0-C:0  -41.422222 -270.847697 188.00325 0.9992817
G:0-C:0  -97.277778 -326.703252 132.14770 0.8948355
H:0-C:0  -82.727778 -312.153252 146.69770 0.9533172
C:1-C:0  235.027778    5.602303 464.45325 0.0404988
D:1-C:0   51.927778 -177.497697 281.35325 0.9969359
G:1-C:0  -79.838889 -309.264364 149.58659 0.9613850
H:1-C:0  -36.866667 -266.292141 192.55881 0.9996665
G:0-D:0  -55.855556 -285.281030 173.56992 0.9951747
H:0-D:0  -41.305556 -270.731030 188.11992 0.9992948
C:1-D:0  276.450000   47.024525 505.87547 0.0071570
D:1-D:0   93.350000 -136.075475 322.77547 0.9137044
G:1-D:0  -38.416667 -267.842141 191.00881 0.9995620
H:1-D:0    4.555556 -224.869919 233.98103 1.0000000
H:0-G:0   14.550000 -214.875475 243.97547 0.9999994
C:1-G:0  332.305556  102.880081 561.73103 0.0004546
D:1-G:0  149.205556  -80.219919 378.63103 0.4832118
G:1-G:0   17.438889 -211.986586 246.86436 0.9999980
H:1-G:0   60.411111 -169.014364 289.83659 0.9922103
```

```
C:1-H:0  317.755556   88.330081 547.18103 0.0009711
D:1-H:0  134.655556  -94.769919 364.08103 0.6153730
G:1-H:0    2.888889 -226.536586 232.31436 1.0000000
H:1-H:0   45.861111 -183.564364 275.28659 0.9986097
D:1-C:1 -183.100000 -412.525475  46.32547 0.2226384
G:1-C:1 -314.866667 -544.292141 -85.44119 0.0011253
H:1-C:1 -271.894444 -501.319919 -42.46897 0.0087832
G:1-D:1 -131.766667 -361.192141  97.65881 0.6413756
H:1-D:1  -88.794444 -318.219919 140.63103 0.9326886
H:1-G:1   42.972222 -186.453252 272.39770 0.9990873

$`Erde:Plasma`
               diff        lwr        upr     p adj
D:0-C:0 -119.600000 -349.02547 109.825475 0.7456073
G:0-C:0 -215.766667 -445.19214  13.658808 0.0814461
H:0-C:0 -133.122222 -362.54770  96.303252 0.6292114
C:1-C:0   -9.527778 -238.95325 219.897697 1.0000000
D:1-C:0 -114.450000 -343.87547 114.975475 0.7857691
G:1-C:0 -205.905556 -435.33103  23.519919 0.1131051
H:1-C:0 -231.027778 -460.45325  -1.602303 0.0471042
G:0-D:0  -96.166667 -325.59214 133.258808 0.9004102
H:0-D:0  -13.522222 -242.94770 215.903252 0.9999996
C:1-D:0  110.072222 -119.35325 339.497697 0.8174487
D:1-D:0    5.150000 -224.27547 234.575475 1.0000000
G:1-D:0  -86.305556 -315.73103 143.119919 0.9417770
H:1-D:0 -111.427778 -340.85325 117.997697 0.8078997
H:0-G:0   82.644444 -146.78103 312.069919 0.9535652
C:1-G:0  206.238889  -23.18659 435.664364 0.1118945
D:1-G:0  101.316667 -128.10881 330.742141 0.8729995
G:1-G:0    9.861111 -219.56436 239.286586 1.0000000
H:1-G:0  -15.261111 -244.68659 214.164364 0.9999992
C:1-H:0  123.594444 -105.83103 353.019919 0.7126159
D:1-H:0   18.672222 -210.75325 248.097697 0.9999967
G:1-H:0  -72.783333 -302.20881 156.642141 0.9768266
H:1-H:0  -97.905556 -327.33103 131.519919 0.8916031
D:1-C:1 -104.922222 -334.34770 124.503252 0.8514515
G:1-C:1 -196.377778 -425.80325  33.047697 0.1522624
H:1-C:1 -221.500000 -450.92547   7.925475 0.0666666
G:1-D:1  -91.455556 -320.88103 137.969919 0.9219737
H:1-D:1 -116.577778 -346.00325 112.847697 0.7695302
H:1-G:1  -25.122222 -254.54770 204.303252 0.9999749

$`AMF:Plasma`
              diff        lwr        upr     p adj
1:0-0:0  209.00000   71.96617 346.033828 0.0006812
0:1-0:0   87.97500  -49.05883 225.008828 0.3431581
1:1-0:0   74.81389  -62.21994 211.847717 0.4885339
0:1-1:0 -121.02500 -258.05883  16.008828 0.1036303
1:1-1:0 -134.18611 -271.21994   2.847717 0.0573031
1:1-0:1  -13.16111 -150.19494 123.872717 0.9944879

$`Erde:AMF:Plasma`
                    diff        lwr         upr     p adj
D:0:0-C:0:0   48.5222222 -319.49213  416.536576 1.0000000
G:0:0-C:0:0  -35.0666667 -403.08102  332.947687 1.0000000
H:0:0-C:0:0  -16.7888889 -384.80324  351.225465 1.0000000
C:1:0-C:0:0  441.5777778   73.56342  809.592131 0.0049481
D:1:0-C:0:0  153.8555556 -214.15880  521.869909 0.9848496
G:1:0-C:0:0   45.1111111 -322.90324  413.125465 1.0000000
H:1:0-C:0:0  192.1222222 -175.89213  560.136576 0.9027329
C:0:1-C:0:0  197.0222222 -170.99213  565.036576 0.8838210
D:0:1-C:0:0   65.6555556 -302.35880  433.669909 0.9999995
G:0:1-C:0:0   37.5333333 -330.48102  405.547687 1.0000000
H:0:1-C:0:0   48.3555556 -319.65880  416.369909 1.0000000
C:1:1-C:0:0  225.5000000 -142.51435  593.514354 0.7346471
D:1:1-C:0:0  147.0222222 -220.99213  515.036576 0.9902330
G:1:1-C:0:0   -7.7666667 -375.78102  360.247687 1.0000000
H:1:1-C:0:0  -68.8333333 -436.84769  299.181020 0.9999990
G:0:0-D:0:0  -83.5888889 -451.60324  284.425465 0.9999871
H:0:0-D:0:0  -65.3111111 -433.32546  302.703242 0.9999995
C:1:0-D:0:0  393.0555556   25.04120  761.069909 0.0240584
```

D:1:0-D:0:0	105.3333333	-262.68102	473.347687	0.9997580
G:1:0-D:0:0	-3.4111111	-371.42546	364.603242	1.0000000
H:1:0-D:0:0	143.6000000	-224.41435	511.614354	0.9922754
C:0:1-D:0:0	148.5000000	-219.51435	516.514354	0.9892253
D:0:1-D:0:0	17.1333333	-350.88102	385.147687	1.0000000
G:0:1-D:0:0	-10.9888889	-379.00324	357.025465	1.0000000
H:0:1-D:0:0	-0.1666667	-368.18102	367.847687	1.0000000
C:1:1-D:0:0	176.9777778	-191.03658	544.992131	0.9480988
D:1:1-D:0:0	98.5000000	-269.51435	466.514354	0.9998939
G:1:1-D:0:0	-56.2888889	-424.30324	311.725465	0.9999999
H:1:1-D:0:0	-117.3555556	-485.36991	250.658798	0.9991305
H:0:0-G:0:0	18.2777778	-349.73658	386.292131	1.0000000
C:1:0-G:0:0	476.6444444	108.63009	844.658798	0.0014043
D:1:0-G:0:0	188.9222222	-179.09213	556.936576	0.9139448
G:1:0-G:0:0	80.1777778	-287.83658	448.192131	0.9999925
H:1:0-G:0:0	227.1888889	-140.82546	595.203242	0.7240179
C:0:1-G:0:0	232.0888889	-135.92546	600.103242	0.6923641
D:0:1-G:0:0	100.7222222	-267.29213	468.736576	0.9998601
G:0:1-G:0:0	72.6000000	-295.41435	440.614354	0.9999980
H:0:1-G:0:0	83.4222222	-284.59213	451.436576	0.9999874
C:1:1-G:0:0	260.5666667	-107.44769	628.581020	0.4964646
D:1:1-G:0:0	182.0888889	-185.92546	550.103242	0.9349318
G:1:1-G:0:0	27.3000000	-340.71435	395.314354	1.0000000
H:1:1-G:0:0	-33.7666667	-401.78102	334.247687	1.0000000
C:1:0-H:0:0	458.3666667	90.35231	826.381020	0.0027379
D:1:0-H:0:0	170.6444444	-197.36991	538.658798	0.9616197
G:1:0-H:0:0	61.9000000	-306.11435	429.914354	0.9999998
H:1:0-H:0:0	208.9111111	-159.10324	576.925465	0.8292575
C:0:1-H:0:0	213.8111111	-154.20324	581.825465	0.8033667
D:0:1-H:0:0	82.4444444	-285.56991	450.458798	0.9999892
G:0:1-H:0:0	54.3222222	-313.69213	422.336576	1.0000000
H:0:1-H:0:0	65.1444444	-302.86991	433.158798	0.9999996
C:1:1-H:0:0	242.2888889	-125.72546	610.303242	0.6234967
D:1:1-H:0:0	163.8111111	-204.20324	531.825465	0.9730739
G:1:1-H:0:0	9.0222222	-358.99213	377.036576	1.0000000
H:1:1-H:0:0	-52.0444444	-420.05880	315.969909	1.0000000
D:1:0-C:1:0	-287.7222222	-655.73658	80.292131	0.3221791
G:1:0-C:1:0	-396.4666667	-764.48102	-28.452313	0.0216737
H:1:0-C:1:0	-249.4555556	-617.46991	118.558798	0.5737298
C:0:1-C:1:0	-244.5555556	-612.56991	123.458798	0.6078276
D:0:1-C:1:0	-375.9222222	-743.93658	-7.907869	0.0399573
G:0:1-C:1:0	-404.0444444	-772.05880	-36.030091	0.0171216
H:0:1-C:1:0	-393.2222222	-761.23658	-25.207869	0.0239366
C:1:1-C:1:0	-216.0777778	-584.09213	151.936576	0.7907700
D:1:1-C:1:0	-294.5555556	-662.56991	73.458798	0.2840719
G:1:1-C:1:0	-449.3444444	-817.35880	-81.330091	0.0037730
H:1:1-C:1:0	-510.4111111	-878.42546	-142.396758	0.0003857
G:1:0-D:1:0	-108.7444444	-476.75880	259.269909	0.9996447
H:1:0-D:1:0	38.2666667	-329.74769	406.281020	1.0000000
C:0:1-D:1:0	43.1666667	-324.84769	411.181020	1.0000000
D:0:1-D:1:0	-88.2000000	-456.21435	279.814354	0.9999739
G:0:1-D:1:0	-116.3222222	-484.33658	251.692131	0.9992149
H:0:1-D:1:0	-105.5000000	-473.51435	262.514354	0.9997533
C:1:1-D:1:0	71.6444444	-296.36991	439.658798	0.9999984
D:1:1-D:1:0	-6.8333333	-374.84769	361.181020	1.0000000
G:1:1-D:1:0	-161.6222222	-529.63658	206.392131	0.9761248
H:1:1-D:1:0	-222.6888889	-590.70324	145.325465	0.7519805
H:1:0-G:1:0	147.0111111	-221.00324	515.025465	0.9902403
C:0:1-G:1:0	151.9111111	-216.10324	519.925465	0.9865772
D:0:1-G:1:0	20.5444444	-347.46991	388.558798	1.0000000
G:0:1-G:1:0	-7.5777778	-375.59213	360.436576	1.0000000
H:0:1-G:1:0	3.2444444	-364.76991	371.258798	1.0000000
C:1:1-G:1:0	180.3888889	-187.62546	548.403242	0.9395448
D:1:1-G:1:0	101.9111111	-266.10324	469.925465	0.9998383
G:1:1-G:1:0	-52.8777778	-420.89213	315.136576	1.0000000
H:1:1-G:1:0	-113.9444444	-481.95880	254.069909	0.9993825
C:0:1-H:1:0	4.9000000	-363.11435	372.914354	1.0000000
D:0:1-H:1:0	-126.4666667	-494.48102	241.547687	0.9979798
G:0:1-H:1:0	-154.5888889	-522.60324	213.425465	0.9841540
H:0:1-H:1:0	-143.7666667	-511.78102	224.247687	0.9921848
C:1:1-H:1:0	33.3777778	-334.63658	401.392131	1.0000000

```
D:1:1-H:1:0  -45.1000000 -413.11435  322.914354 1.0000000
G:1:1-H:1:0 -199.8888889 -567.90324  168.125465 0.8717778
H:1:1-H:1:0 -260.9555556 -628.96991  107.058798 0.4937876
D:0:1-C:0:1 -131.3666667 -499.38102  236.647687 0.9969437
G:0:1-C:0:1 -159.4888889 -527.50324  208.525465 0.9788348
H:0:1-C:0:1 -148.6666667 -516.68102  219.347687 0.9891065
C:1:1-C:0:1   28.4777778 -339.53658  396.492131 1.0000000
D:1:1-C:0:1  -50.0000000 -418.01435  318.014354 1.0000000
G:1:1-C:0:1 -204.7888889 -572.80324  163.225465 0.8495395
H:1:1-C:0:1 -265.8555556 -633.86991  102.158798 0.4603545
G:0:1-D:0:1  -28.1222222 -396.13658  339.892131 1.0000000
H:0:1-D:0:1  -17.3000000 -385.31435  350.714354 1.0000000
C:1:1-D:0:1  159.8444444 -208.16991  527.858798 0.9784005
D:1:1-D:0:1   81.3666667 -286.64769  449.381020 0.9999909
G:1:1-D:0:1  -73.4222222 -441.43658  294.592131 0.9999977
H:1:1-D:0:1 -134.4888889 -502.50324  233.525465 0.9960735
H:0:1-G:0:1   10.8222222 -357.19213  378.836576 1.0000000
C:1:1-G:0:1  187.9666667 -180.04769  555.981020 0.9171197
D:1:1-G:0:1  109.4888889 -258.52546  477.503242 0.9996145
G:1:1-G:0:1  -45.3000000 -413.31435  322.714354 1.0000000
H:1:1-G:0:1 -106.3666667 -474.38102  261.647687 0.9997276
C:1:1-H:0:1  177.1444444 -190.86991  545.158798 0.9477022
D:1:1-H:0:1   98.6666667 -269.34769  466.681020 0.9998917
G:1:1-H:0:1  -56.1222222 -424.13658  311.892131 0.9999999
H:1:1-H:0:1 -117.1888889 -485.20324  250.825465 0.9991446
D:1:1-C:1:1  -78.4777778 -446.49213  289.536576 0.9999944
G:1:1-C:1:1 -233.2666667 -601.28102  134.747687 0.6845940
H:1:1-C:1:1 -294.3333333 -662.34769   73.681020 0.2852670
G:1:1-D:1:1 -154.7888889 -522.80324  213.225465 0.9839600
H:1:1-D:1:1 -215.8555556 -583.86991  152.158798 0.7920216
H:1:1-G:1:1  -61.0666667 -429.08102  306.947687 0.9999998
```

qPCR:

```
> TukeyHSD(anova_result)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = Copiepermg ~ Erde * AMF * Plasma, data = d)

$Erde
          diff       lwr      upr     p adj
D-C  90845.905 -159588.8 341280.6 0.7779409
G-C  83068.224 -174637.4 340773.8 0.8332073
H-C  44951.921 -215526.4 305430.3 0.9690864
G-D  -7777.682 -263261.2 247705.9 0.9998169
H-D -45893.985 -304174.2 212386.2 0.9664120
H-G -38116.303 -303452.5 227219.9 0.9817377

$AMF
      diff      lwr      upr     p adj
1-0 150928 12517.55 289338.4 0.0329352

$Plasma
        diff       lwr      upr     p adj
1-0 131024.9 -7565.616 269615.4 0.0635817

$`Erde:AMF`
               diff       lwr      upr     p adj
D:0-C:0 -40516.99 -481224.4 400190.4 0.9999918
G:0-C:0  22660.75 -418046.7 463368.2 0.9999999
H:0-C:0 -16959.22 -457666.6 423748.2 1.0000000
C:1-C:0  34119.51 -389902.9 458142.0 0.9999967
D:1-C:0 220328.37 -190736.2 631392.9 0.7098032
G:1-C:0 172851.27 -258952.1 604654.6 0.9165532
H:1-C:0 142246.25 -298461.2 582953.7 0.9729611
G:0-D:0  63177.74 -386257.4 512612.9 0.9998524
H:0-D:0  23557.77 -425877.4 472992.9 0.9999998
C:1-D:0  74636.50 -358450.1 507723.1 0.9994295
```

```
D:1-D:0 260845.36 -159562.7 681253.5 0.5367928
G:1-D:0 213368.26 -227339.2 654075.7 0.8036708
H:1-D:0 182763.24 -266671.9 632198.4 0.9099343
H:0-G:0 -39619.97 -489055.1 409815.2 0.9999938
C:1-G:0  11458.76 -421627.8 444545.3 1.0000000
D:1-G:0 197667.62 -222740.5 618075.7 0.8261560
G:1-G:0 150190.52 -290516.9 590898.0 0.9635817
H:1-G:0 119585.50 -329849.7 569020.7 0.9911504
C:1-H:0  51078.73 -382007.8 484165.3 0.9999549
D:1-H:0 237287.59 -183120.5 657695.7 0.6531319
G:1-H:0 189810.49 -250896.9 630517.9 0.8819494
H:1-H:0 159205.47 -290229.7 608640.6 0.9552139
D:1-C:1 186208.87 -216674.5 589092.2 0.8383959
G:1-C:1 138731.76 -285290.7 562754.2 0.9708507
H:1-C:1 108126.75 -324959.8 541213.3 0.9939784
G:1-D:1 -47477.10 -458541.6 363587.4 0.9999609
H:1-D:1 -78082.12 -498490.2 342326.0 0.9990702
H:1-G:1 -30605.02 -471312.4 410102.4 0.9999988

$`Erde:Plasma`
               diff       lwr      upr     p adj
D:0-C:0  -27416.039 -459219.4 404387.3 0.9999994
G:0-C:0   -9610.229 -450317.7 431097.2 1.0000000
H:0-C:0   67037.989 -396019.5 530095.5 0.9998203
C:1-C:0   38483.198 -385539.3 462505.7 0.9999925
D:1-C:0  230587.526 -186574.1 647749.2 0.6767163
G:1-C:0  206991.124 -224812.2 638794.5 0.8115244
H:1-C:0   63383.445 -360639.0 487405.9 0.9997775
G:0-D:0   17805.810 -422901.6 458513.2 1.0000000
H:0-D:0   94454.029 -368603.5 557511.5 0.9982993
C:1-D:0   65899.238 -358123.2 489921.7 0.9997117
D:1-D:0  258003.565 -159158.1 675165.2 0.5409288
G:1-D:0  234407.164 -197396.2 666210.5 0.6963824
H:1-D:0   90799.484 -333223.0 514821.9 0.9976831
H:0-G:0   76648.219 -394723.4 548019.8 0.9996109
C:1-G:0   48093.428 -384993.1 481180.0 0.9999700
D:1-G:0  240197.755 -186173.9 666569.4 0.6553082
G:1-G:0  216601.353 -224106.1 657308.8 0.7913355
H:1-G:0   72993.674 -360092.9 506080.2 0.9995071
C:1-H:0  -28554.791 -484365.2 427255.7 0.9999994
D:1-H:0  163549.537 -285885.6 612984.7 0.9484187
G:1-H:0  139953.135 -323104.4 603010.6 0.9813323
H:1-H:0   -3654.545 -459465.0 452155.9 1.0000000
D:1-C:1  192104.328 -216998.1 601206.7 0.8270993
G:1-C:1  168507.926 -255514.5 592530.4 0.9194669
H:1-C:1   24900.246 -391195.9 440996.3 0.9999996
G:1-D:1  -23596.402 -440758.1 393565.2 0.9999997
H:1-D:1 -167204.081 -576306.5 241898.3 0.9077194
H:1-G:1 -143607.680 -567630.1 280414.8 0.9647883

$`AMF:Plasma`
             diff         lwr      upr     p adj
1:0-0:0  83975.31 -190067.783 358018.4 0.8530831
0:1-0:0  49238.36 -222990.805 321467.5 0.9646811
1:1-0:0 289376.20    9144.788 569607.6 0.0402548
0:1-1:0 -34736.95 -276528.107 207054.2 0.9817332
1:1-1:0 205400.90  -45365.715 456167.5 0.1471037
1:1-0:1 240137.84   -8645.185 488920.9 0.0625330

$`Erde:AMF:Plasma`
                   diff        lwr       upr     p adj
D:0:0-C:0:0   38382.425  -718859.4  795624.3 1.0000000
G:0:0-C:0:0   45191.549  -762031.0  852414.1 1.0000000
H:0:0-C:0:0  -95055.817  -902278.3  712166.7 1.0000000
C:1:0-C:0:0   64583.262  -631155.0  760321.6 1.0000000
D:1:0-C:0:0    5461.196  -669909.6  680832.0 1.0000000
G:1:0-C:0:0   47262.332  -628108.5  722633.1 1.0000000
H:1:0-C:0:0  258336.659  -463665.1  980338.4 0.9962926
C:0:1-C:0:0   56011.094  -639727.2  751749.4 1.0000000
D:0:1-C:0:0  -40503.961  -736242.3  655234.3 1.0000000
```

G:0:1-C:0:0	82058.058	-593312.7	757428.9	1.0000000
H:0:1-C:0:0	80583.843	-594787.0	755954.6	1.0000000
C:1:1-C:0:0	90904.119	-604834.2	786642.4	1.0000000
D:1:1-C:0:0	515866.706	-159504.1	1191237.5	0.3512464
G:1:1-C:0:0	446439.945	-310801.9	1203681.8	0.7725678
H:1:1-C:0:0	96728.196	-625273.6	818730.0	1.0000000
G:0:0-D:0:0	6809.124	-832081.1	845699.4	1.0000000
H:0:0-D:0:0	-133438.243	-972328.5	705452.0	0.9999999
C:1:0-D:0:0	26200.837	-706042.6	758444.3	1.0000000
D:1:0-D:0:0	-32921.229	-745840.8	679998.4	1.0000000
G:1:0-D:0:0	8879.906	-704039.7	721799.5	1.0000000
H:1:0-D:0:0	219954.233	-537287.6	977196.1	0.9996454
C:0:1-D:0:0	17628.668	-714614.8	749872.1	1.0000000
D:0:1-D:0:0	-78886.387	-811129.8	653357.0	1.0000000
G:0:1-D:0:0	43675.633	-669244.0	756595.2	1.0000000
H:0:1-D:0:0	42201.418	-670718.2	755121.0	1.0000000
C:1:1-D:0:0	52521.693	-679721.7	784765.1	1.0000000
D:1:1-D:0:0	477484.280	-235435.3	1190403.9	0.5799125
G:1:1-D:0:0	408057.519	-382855.8	1198970.8	0.9024342
H:1:1-D:0:0	58345.770	-698896.1	815587.6	1.0000000
H:0:0-G:0:0	-140247.366	-1024515.3	744020.6	0.9999999
C:1:0-G:0:0	19391.713	-764428.1	803211.5	1.0000000
D:1:0-G:0:0	-39730.353	-805528.9	726068.2	1.0000000
G:1:0-G:0:0	2070.783	-763727.7	767869.3	1.0000000
H:1:0-G:0:0	213145.110	-594077.4	1020367.6	0.9998887
C:0:1-G:0:0	10819.545	-773000.2	794639.3	1.0000000
D:0:1-G:0:0	-85695.510	-869515.3	698124.3	1.0000000
G:0:1-G:0:0	36866.509	-728932.0	802665.0	1.0000000
H:0:1-G:0:0	35392.294	-730406.2	801190.8	1.0000000
C:1:1-G:0:0	45712.570	-738107.2	829532.3	1.0000000
D:1:1-G:0:0	470675.157	-295123.4	1236473.7	0.7161758
G:1:1-G:0:0	401248.396	-437641.8	1240138.6	0.9447809
H:1:1-G:0:0	51536.647	-755685.9	858759.2	1.0000000
C:1:0-H:0:0	159639.080	-624180.7	943458.8	0.9999961
D:1:0-H:0:0	100517.013	-665281.5	866315.5	1.0000000
G:1:0-H:0:0	142318.149	-623480.4	908116.7	0.9999989
H:1:0-H:0:0	353392.476	-453830.0	1160615.0	0.9736879
C:0:1-H:0:0	151066.911	-632752.9	934886.7	0.9999982
D:0:1-H:0:0	54551.856	-729267.9	838371.6	1.0000000
G:0:1-H:0:0	177113.875	-588684.6	942912.4	0.9999793
H:0:1-H:0:0	175639.661	-590158.9	941438.2	0.9999814
C:1:1-H:0:0	185959.936	-597859.8	969779.7	0.9999712
D:1:1-H:0:0	610922.523	-154876.0	1376721.0	0.2810739
G:1:1-H:0:0	541495.762	-297394.5	1380386.0	0.6412106
H:1:1-H:0:0	191784.013	-615438.5	999006.5	0.9999707
D:1:0-C:1:0	-59122.066	-706339.9	588095.8	1.0000000
G:1:0-C:1:0	-17320.930	-664538.8	629896.9	1.0000000
H:1:0-C:1:0	193753.396	-501984.9	889491.7	0.9997863
C:0:1-C:1:0	-8572.168	-677015.9	659871.6	1.0000000
D:0:1-C:1:0	-105087.223	-773531.0	563356.5	0.9999999
G:0:1-C:1:0	17474.796	-629743.1	664692.7	1.0000000
H:0:1-C:1:0	16000.581	-631217.3	663218.5	1.0000000
C:1:1-C:1:0	26320.857	-642122.9	694764.6	1.0000000
D:1:1-C:1:0	451283.444	-195934.4	1098501.3	0.5100528
G:1:1-C:1:0	381856.682	-350386.8	1114100.1	0.8947861
H:1:1-C:1:0	32144.934	-663593.4	727883.2	1.0000000
G:1:0-D:1:0	41801.136	-583470.7	667073.0	1.0000000
H:1:0-D:1:0	252875.463	-422495.3	928246.3	0.9940636
C:0:1-D:1:0	50549.898	-596668.0	697767.8	1.0000000
D:0:1-D:1:0	-45965.157	-693183.0	601252.7	1.0000000
G:0:1-D:1:0	76596.862	-548675.0	701868.7	1.0000000
H:0:1-D:1:0	75122.647	-550149.2	700394.5	1.0000000
C:1:1-D:1:0	85442.923	-561774.9	732660.8	1.0000000
D:1:1-D:1:0	510405.510	-114866.4	1135677.4	0.2466540
G:1:1-D:1:0	440978.749	-271940.9	1153898.4	0.7069100
H:1:1-D:1:0	91267.000	-584103.8	766637.8	1.0000000
H:1:0-G:1:0	211074.327	-464296.5	886445.1	0.9991655
C:0:1-G:1:0	8748.762	-638469.1	655966.6	1.0000000
D:0:1-G:1:0	-87766.293	-734984.2	559451.6	1.0000000
G:0:1-G:1:0	34795.726	-590476.1	660067.6	1.0000000

```
 H:0:1-G:1:0   33321.512  -591950.4  658593.4 1.0000000
 C:1:1-G:1:0   43641.787  -603576.1  690859.7 1.0000000
 D:1:1-G:1:0  468604.374  -156667.5 1093876.2 0.3835386
 G:1:1-G:1:0  399177.613  -313742.0 1112097.2 0.8319965
 H:1:1-G:1:0   49465.864  -625904.9  724836.7 1.0000000
 C:0:1-H:1:0 -202325.565  -898063.9  493412.7 0.9996405
 D:0:1-H:1:0 -298840.620  -994578.9  396897.7 0.9777916
 G:0:1-H:1:0 -176278.601  -851649.4  499092.2 0.9999036
 H:0:1-H:1:0 -177752.815  -853123.6  497618.0 0.9998931
 C:1:1-H:1:0 -167432.540  -863170.8  528305.8 0.9999654
 D:1:1-H:1:0  257530.047  -417840.8  932900.9 0.9928605
 G:1:1-H:1:0  188103.286  -569138.5  945345.1 0.9999482
 H:1:1-H:1:0 -161608.463  -883610.2  560393.3 0.9999865
 D:0:1-C:0:1  -96515.055  -764958.8  571928.7 1.0000000
 G:0:1-C:0:1   26046.964  -621170.9  673264.8 1.0000000
 H:0:1-C:0:1   24572.750  -622645.1  671790.6 1.0000000
 C:1:1-C:0:1   34893.025  -633550.7  703336.8 1.0000000
 D:1:1-C:0:1  459855.612  -187362.3 1107073.5 0.4768785
 G:1:1-C:0:1  390428.851  -341814.6 1122672.3 0.8774773
 H:1:1-C:0:1   40717.102  -655021.2  736455.4 1.0000000
 G:0:1-D:0:1  122562.019  -524655.9  769779.9 0.9999985
 H:0:1-D:0:1  121087.805  -526130.1  768305.7 0.9999988
 C:1:1-D:0:1  131408.080  -537035.7  799851.8 0.9999976
 D:1:1-D:0:1  556370.667   -90847.2 1203588.5 0.1775270
 G:1:1-D:0:1  486943.906  -245299.5 1219187.3 0.5920043
 H:1:1-D:0:1  137232.157  -558506.1  832970.5 0.9999975
 H:0:1-G:0:1   -1474.215  -626746.1  623797.7 1.0000000
 C:1:1-G:0:1    8846.061  -638371.8  656063.9 1.0000000
 D:1:1-G:0:1  433808.648  -191463.2 1059080.5 0.5188285
 G:1:1-G:0:1  364381.887  -348537.7 1077301.5 0.9087725
 H:1:1-G:0:1   14670.138  -660700.7  690040.9 1.0000000
 C:1:1-H:0:1   10320.275  -636897.6  657538.1 1.0000000
 D:1:1-H:0:1  435282.862  -189989.0 1060554.7 0.5128710
 G:1:1-H:0:1  365856.101  -347063.5 1078775.7 0.9060868
 H:1:1-H:0:1   16144.352  -659226.5  691515.2 1.0000000
 D:1:1-C:1:1  424962.587  -222255.3 1072180.5 0.6132986
 G:1:1-C:1:1  355535.826  -376707.6 1087779.3 0.9378806
 H:1:1-C:1:1    5824.077  -689914.2  701562.4 1.0000000
 G:1:1-D:1:1  -69426.761  -782346.4  643492.9 1.0000000
 H:1:1-D:1:1 -419138.510 -1094509.3  256232.3 0.7020379
 H:1:1-G:1:1 -349711.749 -1106953.6  407530.1 0.9584436


 >
```

Chives fresh

Biomass:

```
TukeyHSD(anova_result)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = Gewicht_frisch ~ Erde * AMF * Plasma, data = d)

$Erde
         diff        lwr      upr     p adj
D-C -19.94722 -101.49269 61.59824 0.9199430
G-C -56.60000 -138.14547 24.94547 0.2748972
H-C -38.45000 -119.99547 43.09547 0.6106541
G-D -36.65278 -118.19824 44.89269 0.6468014
H-D -18.50278 -100.04824 63.04269 0.9347502
H-G  18.15000  -63.39547 99.69547 0.9381090

$AMF
        diff      lwr      upr     p adj
1-0 59.22361 15.39405 103.0532 0.0084817

$Plasma
        diff      lwr      upr p adj
```

```
1-0 215.8514 172.0218 259.6809     0

$`Erde:AMF`
                diff          lwr       upr     p adj
D:0-C:0    33.105556 -103.419911 169.63102 0.9952924
G:0-C:0     9.094444 -127.431022 145.61991 0.9999992
H:0-C:0    25.000000 -111.525467 161.52547 0.9992123
C:1-C:0   150.322222   13.796755 286.84769 0.0201238
D:1-C:0    77.322222  -59.203245 213.84769 0.6576692
G:1-C:0    28.027778 -108.497689 164.55324 0.9983503
H:1-C:0    48.422222  -88.103245 184.94769 0.9572395
G:0-D:0   -24.011111 -160.536578 112.51436 0.9993950
H:0-D:0    -8.105556 -144.631022 128.41991 0.9999996
C:1-D:0   117.216667  -19.308800 253.74213 0.1495272
D:1-D:0    44.216667  -92.308800 180.74213 0.9739732
G:1-D:0    -5.077778 -141.603245 131.44769 1.0000000
H:1-D:0    15.316667 -121.208800 151.84213 0.9999703
H:0-G:0    15.905556 -120.619911 152.43102 0.9999616
C:1-G:0   141.227778    4.702311 277.75324 0.0370782
D:1-G:0    68.227778  -68.297689 204.75324 0.7842350
G:1-G:0    18.933333 -117.592133 155.45880 0.9998753
H:1-G:0    39.327778  -97.197689 175.85324 0.9867013
C:1-H:0   125.322222  -11.203245 261.84769 0.0969891
D:1-H:0    52.322222  -84.203245 188.84769 0.9359634
G:1-H:0     3.027778 -133.497689 139.55324 1.0000000
H:1-H:0    23.422222 -113.103245 159.94769 0.9994861
D:1-C:1   -73.000000 -209.525467  63.52547 0.7203484
G:1-C:1 -122.294444 -258.819911  14.23102 0.1145522
H:1-C:1 -101.900000 -238.425467  34.62547 0.3017224
G:1-D:1   -49.294444 -185.819911  87.23102 0.9529898
H:1-D:1   -28.900000 -165.425467 107.62547 0.9979937
H:1-G:1    20.394444 -116.131022 156.91991 0.9997948

$`Erde:Plasma`
              diff        lwr       upr     p adj
D:0-C:0 -46.638889 -183.16436  89.88658 0.9650692
G:0-C:0 -43.966667 -180.49213  92.55880 0.9747860
H:0-C:0 -68.427778 -204.95324  68.09769 0.7816969
C:1-C:0 193.833333   57.30787 330.35880 0.0006427
D:1-C:0 200.577778   64.05231 337.10324 0.0003526
G:1-C:0 124.600000  -11.92547 261.12547 0.1009677
H:1-C:0 185.361111   48.83564 321.88658 0.0013350
G:0-D:0   2.672222 -133.85324 139.19769 1.0000000
H:0-D:0 -21.788889 -158.31436 114.73658 0.9996813
C:1-D:0 240.472222  103.94676 376.99769 0.0000075
D:1-D:0 247.216667  110.69120 383.74213 0.0000038
G:1-D:0 171.238889   34.71342 307.76436 0.0042453
H:1-D:0 232.000000   95.47453 368.52547 0.0000177
H:0-G:0 -24.461111 -160.98658 112.06436 0.9993168
C:1-G:0 237.800000  101.27453 374.32547 0.0000099
D:1-G:0 244.544444  108.01898 381.06991 0.0000050
G:1-G:0 168.566667   32.04120 305.09213 0.0052358
H:1-G:0 229.327778   92.80231 365.85324 0.0000231
C:1-H:0 262.261111  125.73564 398.78658 0.0000008
D:1-H:0 269.005556  132.48009 405.53102 0.0000004
G:1-H:0 193.027778   56.50231 329.55324 0.0006898
H:1-H:0 253.788889  117.26342 390.31436 0.0000019
D:1-C:1   6.744444 -129.78102 143.26991 0.9999999
G:1-C:1 -69.233333 -205.75880  67.29213 0.7713413
H:1-C:1  -8.472222 -144.99769 128.05324 0.9999995
G:1-D:1 -75.977778 -212.50324  60.54769 0.6775449
H:1-D:1 -15.216667 -151.74213 121.30880 0.9999716
H:1-G:1  60.761111  -75.76436 197.28658 0.8684427

$`AMF:Plasma`
             diff       lwr       upr     p adj
1:0-0:0  14.61111 -66.93436  96.15658 0.9662516
0:1-0:0 171.23889  89.69342 252.78436 0.0000014
1:1-0:0 275.07500 193.52953 356.62047 0.0000000
0:1-1:0 156.62778  75.08231 238.17324 0.0000109
1:1-1:0 260.46389 178.91842 342.00936 0.0000000
```

```
1:1-0:1 103.83611  22.29064 185.38158 0.0064785

$`Erde:AMF:Plasma`
                      diff         lwr       upr     p adj
D:0:0-C:0:0   38.1222222 -180.874084 257.11853 0.9999996
G:0:0-C:0:0   37.4666667 -181.529639 256.46297 0.9999997
H:0:0-C:0:0   36.6888889 -182.307417 255.68519 0.9999998
C:1:0-C:0:0  150.2666667  -68.729639 369.26297 0.5523627
D:1:0-C:0:0   18.8666667 -200.129639 237.86297 1.0000000
G:1:0-C:0:0   24.8666667 -194.129639 243.86297 1.0000000
H:1:0-C:0:0  -23.2777778 -242.274084 195.71853 1.0000000
C:0:1-C:0:0  193.7777778  -25.218528 412.77408 0.1477900
D:0:1-C:0:0  221.8666667    2.870361 440.86297 0.0436424
G:0:1-C:0:0  174.5000000  -44.496306 393.49631 0.2911902
H:0:1-C:0:0  207.0888889  -11.907417 426.08519 0.0855817
C:1:1-C:0:0  344.1555556  125.159250 563.15186 0.0000234
D:1:1-C:0:0  329.5555556  110.559250 548.55186 0.0000663
G:1:1-C:0:0  224.9666667    5.970361 443.96297 0.0375797
H:1:1-C:0:0  313.9000000   94.903694 532.89631 0.0001952
G:0:0-D:0:0   -0.6555556 -219.651861 218.34075 1.0000000
H:0:0-D:0:0   -1.4333333 -220.429639 217.56297 1.0000000
C:1:0-D:0:0  112.1444444 -106.851861 331.14075 0.9155099
D:1:0-D:0:0  -19.2555556 -238.251861 199.74075 1.0000000
G:1:0-D:0:0  -13.2555556 -232.251861 205.74075 1.0000000
H:1:0-D:0:0  -61.4000000 -280.396306 157.59631 0.9998118
C:0:1-D:0:0  155.6555556  -63.340750 374.65186 0.4895448
D:0:1-D:0:0  183.7444444  -35.251861 402.74075 0.2140730
G:0:1-D:0:0  136.3777778  -82.618528 355.37408 0.7113119
H:0:1-D:0:0  168.9666667  -50.029639 387.96297 0.3444212
C:1:1-D:0:0  306.0333333   87.037028 525.02964 0.0003311
D:1:1-D:0:0  291.4333333   72.437028 510.42964 0.0008581
G:1:1-D:0:0  186.8444444  -32.151861 405.84075 0.1916744
H:1:1-D:0:0  275.7777778   56.781472 494.77408 0.0022807
H:0:0-G:0:0   -0.7777778 -219.774084 218.21853 1.0000000
C:1:0-G:0:0  112.8000000 -106.196306 331.79631 0.9117959
D:1:0-G:0:0  -18.6000000 -237.596306 200.39631 1.0000000
G:1:0-G:0:0  -12.6000000 -231.596306 206.39631 1.0000000
H:1:0-G:0:0  -60.7444444 -279.740750 158.25186 0.9998350
C:0:1-G:0:0  156.3111111  -62.685195 375.30742 0.4819931
D:0:1-G:0:0  184.4000000  -34.596306 403.39631 0.2091909
G:0:1-G:0:0  137.0333333  -81.962972 356.02964 0.7041885
H:0:1-G:0:0  169.6222222  -49.374084 388.61853 0.3378586
C:1:1-G:0:0  306.6888889   87.692583 525.68519 0.0003170
D:1:1-G:0:0  292.0888889   73.092583 511.08519 0.0008229
G:1:1-G:0:0  187.5000000  -31.496306 406.49631 0.1871606
H:1:1-G:0:0  276.4333333   57.437028 495.42964 0.0021914
C:1:0-H:0:0  113.5777778 -105.418528 332.57408 0.9072524
D:1:0-H:0:0  -17.8222222 -236.818528 201.17408 1.0000000
G:1:0-H:0:0  -11.8222222 -230.818528 207.17408 1.0000000
H:1:0-H:0:0  -59.9666667 -278.962972 159.02964 0.9998592
C:0:1-H:0:0  157.0888889  -61.907417 376.08519 0.4730704
D:0:1-H:0:0  185.1777778  -33.818528 404.17408 0.2034999
G:0:1-H:0:0  137.8111111  -81.185195 356.80742 0.6956643
H:0:1-H:0:0  170.4000000  -48.596306 389.39631 0.3301588
C:1:1-H:0:0  307.4666667   88.470361 526.46297 0.0003010
D:1:1-H:0:0  292.8666667   73.870361 511.86297 0.0007828
G:1:1-H:0:0  188.2777778  -30.718528 407.27408 0.1819053
H:1:1-H:0:0  277.2111111   58.214805 496.20742 0.0020897
D:1:0-C:1:0 -131.4000000 -350.396306  87.59631 0.7632845
G:1:0-C:1:0 -125.4000000 -344.396306  93.59631 0.8198691
H:1:0-C:1:0 -173.5444444 -392.540750  45.45186 0.3000221
C:0:1-C:1:0   43.5111111 -175.485195 262.50742 0.9999978
D:0:1-C:1:0   71.6000000 -147.396306 290.59631 0.9988433
G:0:1-C:1:0   24.2333333 -194.762972 243.22964 1.0000000
H:0:1-C:1:0   56.8222222 -162.174084 275.81853 0.9999281
C:1:1-C:1:0  193.8888889  -25.107417 412.88519 0.1471547
D:1:1-C:1:0  179.2888889  -39.707417 398.28519 0.2493260
G:1:1-C:1:0   74.7000000 -144.296306 293.69631 0.9981391
H:1:1-C:1:0  163.6333333  -55.362972 382.62964 0.4001129
G:1:0-D:1:0    6.0000000 -212.996306 224.99631 1.0000000
H:1:0-D:1:0  -42.1444444 -261.140750 176.85186 0.9999986
```

```
C:0:1-D:1:0  174.9111111  -44.085195 393.90742 0.2874385
D:0:1-D:1:0  203.0000000  -15.996306 421.99631 0.1018645
G:0:1-D:1:0  155.6333333  -63.362972 374.62964 0.4898013
H:0:1-D:1:0  188.2222222  -30.774084 407.21853 0.1822770
C:1:1-D:1:0  325.2888889  106.292583 544.28519 0.0000893
D:1:1-D:1:0  310.6888889   91.692583 529.68519 0.0002425
G:1:1-D:1:0  206.1000000  -12.896306 425.09631 0.0893085
H:1:1-D:1:0  295.0333333   76.037028 514.02964 0.0006809
H:1:0-G:1:0  -48.1444444 -267.140750 170.85186 0.9999916
C:0:1-G:1:0  168.9111111  -50.085195 387.90742 0.3449804
D:0:1-G:1:0  197.0000000  -21.996306 415.99631 0.1302036
G:0:1-G:1:0  149.6333333  -69.362972 368.62964 0.5597910
H:0:1-G:1:0  182.2222222  -36.774084 401.21853 0.2257112
C:1:1-G:1:0  319.2888889  100.292583 538.28519 0.0001352
D:1:1-G:1:0  304.6888889   85.692583 523.68519 0.0003620
G:1:1-G:1:0  200.1000000  -18.896306 419.09631 0.1148708
H:1:1-G:1:0  289.0333333   70.037028 508.02964 0.0009999
C:0:1-H:1:0  217.0555556   -1.940750 436.05186 0.0547397
D:0:1-H:1:0  245.1444444   26.148139 464.14075 0.0133122
G:0:1-H:1:0  197.7777778  -21.218528 416.77408 0.1262135
H:0:1-H:1:0  230.3666667   11.370361 449.36297 0.0287729
C:1:1-H:1:0  367.4333333  148.437028 586.42964 0.0000042
D:1:1-H:1:0  352.8333333  133.837028 571.82964 0.0000124
G:1:1-H:1:0  248.2444444   29.248139 467.24075 0.0112454
H:1:1-H:1:0  337.1777778  118.181472 556.17408 0.0000386
D:0:1-C:0:1   28.0888889 -190.907417 247.08519 1.0000000
G:0:1-C:0:1  -19.2777778 -238.274084 199.71853 1.0000000
H:0:1-C:0:1   13.3111111 -205.685195 232.30742 1.0000000
C:1:1-C:0:1  150.3777778  -68.618528 369.37408 0.5510598
D:1:1-C:0:1  135.7777778  -83.218528 354.77408 0.7177799
G:1:1-C:0:1   31.1888889 -187.807417 250.18519 1.0000000
H:1:1-C:0:1  120.1222222  -98.874084 339.11853 0.8630786
G:0:1-D:0:1  -47.3666667 -266.362972 171.62964 0.9999932
H:0:1-D:0:1  -14.7777778 -233.774084 204.21853 1.0000000
C:1:1-D:0:1  122.2888889  -96.707417 341.28519 0.8461346
D:1:1-D:0:1  107.6888889 -111.307417 326.68519 0.9380032
G:1:1-D:0:1    3.1000000 -215.896306 222.09631 1.0000000
H:1:1-D:0:1   92.0333333 -126.962972 311.02964 0.9840869
H:0:1-G:0:1   32.5888889 -186.407417 251.58519 1.0000000
C:1:1-G:0:1  169.6555556  -49.340750 388.65186 0.3375266
D:1:1-G:0:1  155.0555556  -63.940750 374.05186 0.4964793
G:1:1-G:0:1   50.4666667 -168.529639 269.46297 0.9999843
H:1:1-G:0:1  139.4000000  -79.596306 358.39631 0.6780241
C:1:1-H:0:1  137.0666667  -81.929639 356.06297 0.7038248
D:1:1-H:0:1  122.4666667  -96.529639 341.46297 0.8446944
G:1:1-H:0:1   17.8777778 -201.118528 236.87408 1.0000000
H:1:1-H:0:1  106.8111111 -112.185195 325.80742 0.9418846
D:1:1-C:1:1  -14.6000000 -233.596306 204.39631 1.0000000
G:1:1-C:1:1 -119.1888889 -338.185195  99.80742 0.8700264
H:1:1-C:1:1  -30.2555556 -249.251861 188.74075 1.0000000
G:1:1-D:1:1 -104.5888889 -323.585195 114.40742 0.9509376
H:1:1-D:1:1  -15.6555556 -234.651861 203.34075 1.0000000
H:1:1-G:1:1   88.9333333 -130.062972 307.92964 0.9885351
```

qPCR:

```
TukeyHSD(anova_result)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = Copiepermg ~ Erde * AMF * Plasma, data = d)

$Erde
         diff        lwr      upr     p adj
D-C -2491.537 -45705.942 40722.87 0.9987724
G-C 10113.853 -34308.372 54536.08 0.9333444
H-C 33286.915  -9237.198 75811.03 0.1784939
G-D 12605.391 -31446.524 56657.31 0.8773546
H-D 35778.453  -6358.673 77915.58 0.1252073
H-G 23173.062 -20201.892 66548.02 0.5046596
```

```
$AMF
        diff     lwr      upr     p adj
1-0 44207.78 21010.3 67405.25 0.0002678

$Plasma
         diff       lwr      upr     p adj
1-0 -18156.05 -41367.83 5055.716 0.1238298

$`Erde:AMF`
              diff         lwr       upr     p adj
D:0-C:0   4790.329 -68268.187  77848.84 0.9999992
G:0-C:0  -2766.298 -75824.814  70292.22 1.0000000
H:0-C:0  23581.754 -48248.800  95412.31 0.9708380
C:1-C:0  36349.761 -36708.755 109408.28 0.7832265
D:1-C:0  25850.156 -45980.398  97680.71 0.9521455
G:1-C:0  64519.604 -11522.111 140561.32 0.1585466
H:1-C:0  77599.334   6860.730 148337.94 0.0211936
G:0-D:0  -7556.627 -80615.143  65501.89 0.9999820
H:0-D:0  18791.425 -53039.129  90621.98 0.9921742
C:1-D:0  31559.432 -41499.084 104617.95 0.8819504
D:1-D:0  21059.828 -50770.727  92890.38 0.9846360
G:1-D:0  59729.275 -16312.439 135770.99 0.2375249
H:1-D:0  72809.006   2070.402 143547.61 0.0389450
H:0-G:0  26348.052 -45482.502  98178.61 0.9471279
C:1-G:0  39116.059 -33942.457 112174.57 0.7135714
D:1-G:0  28616.454 -43214.100 100447.01 0.9197108
G:1-G:0  67285.902  -8755.813 143327.62 0.1229213
H:1-G:0  80365.632   9627.028 151104.24 0.0146444
C:1-H:0  12768.007 -59062.547  84598.56 0.9993181
D:1-H:0   2268.402 -68312.830  72849.63 1.0000000
G:1-H:0  40937.850 -33924.852 115800.55 0.6912006
H:1-H:0  54017.580 -15452.067 123487.23 0.2490445
D:1-C:1 -10499.605 -82330.159  61330.95 0.9998131
G:1-C:1  28169.843 -47871.872 104211.56 0.9443497
H:1-C:1  41249.573 -29489.031 111988.18 0.6174529
G:1-D:1  38669.447 -36193.254 113532.15 0.7492304
H:1-D:1  51749.178 -17720.469 121218.83 0.3003244
H:1-G:1  13079.731 -60735.889  86895.35 0.9993320

$`Erde:Plasma`
              diff        lwr       upr     p adj
D:0-C:0  -9803.813  -84254.04  64646.42 0.9999073
G:0-C:0   3159.944  -72656.46  78976.35 1.0000000
H:0-C:0  14803.089  -58442.52  88048.69 0.9984340
C:1-C:0 -33492.771 -106738.38  39752.84 0.8476198
D:1-C:0 -30355.688 -103601.29  42889.92 0.9027917
G:1-C:0 -18817.350  -94633.75  56999.06 0.9943164
H:1-C:0  15851.800  -56323.27  88026.87 0.9973426
G:0-D:0  12963.757  -61486.47  87413.99 0.9994042
H:0-D:0  24606.902  -47223.65  96437.46 0.9632042
C:1-D:0 -23688.958  -95519.51  48141.60 0.9700991
D:1-D:0 -20551.875  -92382.43  51278.68 0.9866735
G:1-D:0  -9013.537  -83463.77  65436.70 0.9999475
H:1-D:0  25655.613  -45082.99  96394.22 0.9501567
H:0-G:0  11643.145  -61602.46  84888.75 0.9996733
C:1-G:0 -36652.715 -109898.32  36592.89 0.7782337
D:1-G:0 -33515.633 -106761.24  39729.97 0.8471654
G:1-G:0 -21977.294  -97793.70  53839.11 0.9856180
H:1-G:0  12691.856  -59483.21  84866.92 0.9993645
C:1-H:0 -48295.860 -118877.09  22285.37 0.4100320
D:1-H:0 -45158.777 -115740.01  25422.45 0.4993536
G:1-H:0 -33620.439 -106866.04  39625.17 0.8450727
H:1-H:0   1048.711  -68420.94  70518.36 1.0000000
D:1-C:1   3137.083  -67444.15  73718.31 0.9999999
G:1-C:1  14675.421  -58570.18  87921.03 0.9985186
H:1-C:1  49344.571  -20125.08 118814.22 0.3608453
G:1-D:1  11538.338  -61707.27  84783.94 0.9996923
H:1-D:1  46207.488  -23262.16 115677.14 0.4477581
H:1-G:1  34669.150  -37505.92 106844.22 0.8120888
```

```
$`AMF:Plasma`
              diff         lwr       upr     p adj
1:0-0:0  38481.57   -5512.041  82475.17 0.1082931
0:1-0:0 -24019.13  -67233.538  19195.27 0.4699571
1:1-0:0  26142.87  -16716.275  69002.01 0.3866390
0:1-1:0 -62500.70 -106120.357 -18881.04 0.0017082
1:1-1:0 -12338.70  -55606.421  30929.02 0.8784372
1:1-0:1  50162.00    7686.794  92637.21 0.0137950

$`Erde:AMF:Plasma`
                      diff          lwr       upr     p adj
D:0:0-C:0:0  11642.44954 -110456.8806 133741.78 1.0000000
G:0:0-C:0:0  11767.96742 -110331.3627 133867.30 1.0000000
H:0:0-C:0:0  29334.85300  -89190.0612 147859.77 0.9999541
C:1:0-C:0:0  59807.30726  -62292.0229 181906.64 0.9356342
D:1:0-C:0:0  29629.03864  -92470.2915 151728.37 0.9999643
G:1:0-C:0:0  59849.23248  -66859.2306 186557.70 0.9517655
H:1:0-C:0:0  58473.46115  -63625.8690 180572.79 0.9460953
C:0:1-C:0:0 -10884.82984 -129409.7440 107640.08 1.0000000
D:0:1-C:0:0 -12587.58729 -134686.9175 109511.74 1.0000000
G:0:1-C:0:0 -28418.59216 -150517.9223  93680.74 0.9999791
H:0:1-C:0:0   6984.59137 -115114.7388 129083.92 1.0000000
C:1:1-C:0:0   3666.00240 -118433.3278 125765.33 1.0000000
D:1:1-C:0:0  12118.87641 -106406.0378 130643.79 1.0000000
G:1:1-C:0:0  58689.48944  -68018.9736 185397.95 0.9589379
H:1:1-C:0:0  81613.20341  -34055.2690 197281.68 0.4935348
G:0:0-D:0:0    125.51788 -117183.7240 117434.76 1.0000000
H:0:0-D:0:0  17692.40346  -95891.7816 131276.59 0.9999999
C:1:0-D:0:0  48164.85772  -69144.3842 165474.10 0.9859831
D:1:0-D:0:0  17986.58910  -99322.6528 135295.83 0.9999999
G:1:0-D:0:0  48206.78294  -73892.5472 170306.11 0.9903937
H:1:0-D:0:0  46831.01161  -70478.2303 164140.25 0.9892964
C:0:1-D:0:0 -22527.27938 -136111.4645  91056.91 0.9999975
D:0:1-D:0:0 -24230.03684 -141539.2788  93079.21 0.9999957
G:0:1-D:0:0 -40061.04170 -157370.2836  77248.20 0.9978754
H:0:1-D:0:0  -4657.85817 -121967.1001 112651.38 1.0000000
C:1:1-D:0:0  -7976.44715 -125285.6891 109332.79 1.0000000
D:1:1-D:0:0    476.42687 -113107.7582 114060.61 1.0000000
G:1:1-D:0:0  47047.03990  -75052.2903 169146.37 0.9924558
H:1:1-D:0:0  69970.75387  -40629.4601 180570.97 0.6776983
H:0:0-G:0:0  17566.88558  -96017.2995 131151.07 0.9999999
C:1:0-G:0:0  48039.33984  -69269.9021 165348.58 0.9863260
D:1:0-G:0:0  17861.07121  -99448.1707 135170.31 0.9999999
G:1:0-G:0:0  48081.26506  -74018.0651 170180.60 0.9906368
H:1:0-G:0:0  46705.49373  -70603.7482 164014.74 0.9895725
C:0:1-G:0:0 -22652.79726 -136236.9823  90931.39 0.9999973
D:0:1-G:0:0 -24355.55472 -141664.7966  92953.69 0.9999954
G:0:1-G:0:0 -40186.55958 -157495.8015  77122.68 0.9978015
H:0:1-G:0:0  -4783.37605 -122092.6180 112525.87 1.0000000
C:1:1-G:0:0  -8101.96503 -125411.2070 109207.28 1.0000000
D:1:1-G:0:0    350.90899 -113233.2761 113935.09 1.0000000
G:1:1-G:0:0  46921.52202  -75177.8082 169020.85 0.9926554
H:1:1-G:0:0  69845.23599  -40754.9780 180445.45 0.6804652
C:1:0-H:0:0  30472.45426  -83111.7308 144056.64 0.9998737
D:1:0-H:0:0    294.18564 -113289.9994 113878.37 1.0000000
G:1:0-H:0:0  30514.37948  -88010.5347 149039.29 0.9999244
H:1:0-H:0:0  29138.60815  -84445.5769 142722.79 0.9999277
C:0:1-H:0:0 -40219.68284 -149952.4307  69513.07 0.9954759
D:0:1-H:0:0 -41922.44029 -155506.6254  71661.74 0.9951359
G:0:1-H:0:0 -57753.44516 -171337.6302  55830.74 0.9146935
H:0:1-H:0:0 -22350.26163 -135934.4467  91233.92 0.9999977
C:1:1-H:0:0 -25668.85060 -139253.0357  87915.33 0.9999858
D:1:1-H:0:0 -17215.97659 -126948.7245  92516.77 0.9999999
G:1:1-H:0:0  29354.63644  -89170.2778 147879.55 0.9999537
H:1:1-H:0:0  52278.35041  -54362.7120 158919.41 0.9352241
D:1:0-C:1:0 -30178.26862 -147487.5105  87130.97 0.9999251
G:1:0-C:1:0     41.92522 -122057.4050 122141.26 1.0000000
H:1:0-C:1:0  -1333.84611 -118643.0880 115975.40 1.0000000
C:0:1-C:1:0 -70692.13710 -184276.3222  42892.05 0.7024819
D:0:1-C:1:0 -72394.89455 -189704.1365  44914.35 0.7149074
```

G:0:1-C:1:0	-88225.89942	-205535.1413	29083.34	0.3810890
H:0:1-C:1:0	-52822.71589	-170131.9578	64486.53	0.9676740
C:1:1-C:1:0	-56141.30486	-173450.5468	61167.94	0.9463872
D:1:1-C:1:0	-47688.43085	-161272.6159	65895.75	0.9827180
G:1:1-C:1:0	-1117.81782	-123217.1480	120981.51	1.0000000
H:1:1-C:1:0	21805.89615	-88794.3178	132406.11	0.9999977
G:1:0-D:1:0	30220.19384	-91879.1363	152319.52	0.9999540
H:1:0-D:1:0	28844.42251	-88464.8194	146153.66	0.9999577
C:0:1-D:1:0	-40513.86848	-154098.0536	73070.32	0.9966027
D:0:1-D:1:0	-42216.62593	-159525.8679	75092.62	0.9962666
G:0:1-D:1:0	-58047.63080	-175356.8727	59261.61	0.9304054
H:0:1-D:1:0	-22644.44727	-139953.6892	94664.79	0.9999983
C:1:1-D:1:0	-25963.03624	-143272.2782	91346.21	0.9999892
D:1:1-D:1:0	-17510.16222	-131094.3473	96074.02	0.9999999
G:1:1-D:1:0	29060.45080	-93038.8794	151159.78	0.9999722
H:1:1-D:1:0	51984.16477	-58616.0492	162584.38	0.9536627
H:1:0-G:1:0	-1375.77133	-123475.1015	120723.56	1.0000000
C:0:1-G:1:0	-70734.06232	-189258.9765	47790.85	0.7612236
D:0:1-G:1:0	-72436.81977	-194536.1499	49662.51	0.7689123
G:0:1-G:1:0	-88267.82464	-210367.1548	33831.51	0.4504434
H:0:1-G:1:0	-52864.64111	-174963.9713	69234.69	0.9771123
C:1:1-G:1:0	-56183.23008	-178282.5603	65916.10	0.9611385
D:1:1-G:1:0	-47730.35607	-166255.2703	70794.56	0.9883538
G:1:1-G:1:0	-1159.74304	-127868.2061	125548.72	1.0000000
H:1:1-G:1:0	21763.97093	-93904.5015	137432.44	0.9999988
C:0:1-H:1:0	-69358.29099	-182942.4761	44225.89	0.7300327
D:0:1-H:1:0	-71061.04844	-188370.2904	46248.19	0.7411855
G:0:1-H:1:0	-86892.05331	-204201.2952	30417.19	0.4075758
H:0:1-H:1:0	-51488.86978	-168798.1117	65820.37	0.9741464
C:1:1-H:1:0	-54807.45875	-172116.7007	62501.78	0.9558911
D:1:1-H:1:0	-46354.58474	-159938.7698	67229.60	0.9867653
G:1:1-H:1:0	216.02829	-121883.3019	122315.36	1.0000000
H:1:1-H:1:0	23139.74226	-87460.4717	133739.96	0.9999949
D:0:1-C:0:1	-1702.75745	-115286.9425	111881.43	1.0000000
G:0:1-C:0:1	-17533.76232	-131117.9474	96050.42	0.9999999
H:0:1-C:0:1	17869.42121	-95714.7639	131453.61	0.9999999
C:1:1-C:0:1	14550.83224	-99033.3529	128135.02	1.0000000
D:1:1-C:0:1	23003.70625	-86729.0416	132736.45	0.9999947
G:1:1-C:0:1	69574.31928	-48950.5949	188099.23	0.7822933
H:1:1-C:0:1	92498.03325	-14143.0291	199139.10	0.1681591
G:0:1-D:0:1	-15831.00486	-133140.2468	101478.24	1.0000000
H:0:1-D:0:1	19572.17867	-97737.0633	136881.42	0.9999998
C:1:1-D:0:1	16253.58969	-101055.6522	133562.83	1.0000000
D:1:1-D:0:1	24706.46371	-88877.7214	138290.65	0.9999914
G:1:1-D:0:1	71277.07674	-50822.2534	193376.41	0.7890738
H:1:1-D:0:1	94200.79070	-16399.4232	204801.00	0.1905441
H:0:1-G:0:1	35403.18353	-81906.0584	152712.43	0.9994777
C:1:1-G:0:1	32084.59455	-85224.6474	149393.84	0.9998398
D:1:1-G:0:1	40537.46857	-73046.7165	154121.65	0.9965816
G:1:1-G:0:1	87108.08160	-34991.2486	209207.41	0.4739161
H:1:1-G:0:1	110031.79557	-568.4184	220632.01	0.0526552
C:1:1-H:0:1	-3318.58898	-120627.8309	113990.65	1.0000000
D:1:1-H:0:1	5134.28504	-108449.9000	118718.47	1.0000000
G:1:1-H:0:1	51704.89807	-70394.4321	173804.23	0.9812937
H:1:1-H:0:1	74628.61204	-35971.6019	185228.83	0.5718574
D:1:1-C:1:1	8452.87402	-105131.3111	122037.06	1.0000000
G:1:1-C:1:1	55023.48705	-67075.8431	177122.82	0.9674513
H:1:1-C:1:1	77947.20101	-32653.0129	188547.41	0.4955802
G:1:1-D:1:1	46570.61303	-71954.3012	165095.53	0.9908386
H:1:1-D:1:1	69494.32700	-37146.7354	176135.39	0.6304981
H:1:1-G:1:1	22923.71397	-92744.7585	138592.19	0.9999975

Appendix E: Materials and Supplementary Strain Information

E.1 Strain Information – Rhizoglomus irregulare SAF22

The arbuscular mycorrhizal fungus (AMF) used in this study was Rhizoglomus irregulare SAF22. This strain is maintained and distributed by Agroscope (Switzerland) and is widely recognized for its effectiveness in colonizing a broad range of host plants under both greenhouse and field conditions. SAF22 is a single-spore line derived from the DAOM197198 strain and has been characterized for high symbiotic performance and consistent root colonization under diverse soil conditions.

Reference: Agroscope (2016). Rhizoglomus irregulare – Strain SAF22. https://www.agroscope.admin.ch

E.2 List of Materials and Equipment

Instruments and Laboratory Devices:

FastPrep-24™ 5G (MP Biomedicals, USA)

Beta 1-8K Freeze Dryer (Christ)

NanoDrop One (Thermo Scientific)

Vortex Genie 2 (Merck)

Sigma 4-16KS Centrifuge (Kuhner)

Biofuge Pico Centrifuge (Heraeus Instruments)

pipetmaX® Automated Pipetting System (Gilson)

CFX Opus 384 Real-Time PCR System (Bio-Rad)

Cary Eclipse Fluorescence Spectrometer (Varian)

Reagents and Kits:

NucleoSpin® 96 Plant II DNA Kit (Macherey-Nagel)

5× HOT FIREPol® EvaGreen® qPCR Mix Plus

AMG1F (Forward primer) & AM1 (Reverse primer)

Culture Media:

LB (Lysogeny Broth Agar, Lennox) – Roth Chemie GmbH

YMA (Yeast Mannitol Agar) – NutriSelect® Plus (Merck KGaA, Darmstadt, Germany)

Appendix F: DNA Extraction Protocol

DNA was extracted from root samples using the **NucleoSpin® 96 Plant II DNA extraction kit** (Macherey-Nagel, Germany), following an adapted vacuum-based protocol.

F.1 Sample Preparation

1. Approximately **20 mg** of freeze-dried and ground plant root material was transferred to 2 mL Eppendorf tubes.
2. **3–4 glass beads (3 mm)** were added to each tube.
3. Samples were homogenized using a **FastPrep-24™ 5G homogenizer** (MP Biomedicals, USA) at **6 m/s for 1 minute**. Homogenization was repeated if root tissue was not fully disrupted.

F.2 Cell Lysis

4. Each sample was incubated in **500 µL Buffer PL1** and **10 µL RNase A** in 50 mL Falcon tubes.
5. The samples were mixed using FastPrep at **6 m/s for 30 seconds** with 510 µL PL1 Mix.
6. For absorbent materials, Buffer PL1 volume was increased by **200–300 µL**.
7. Samples were incubated at **65°C for 30 minutes** in a water bath.

F.3 Lysate Clarification

8. Samples were centrifuged at **16,000 × g for 5 minutes** to clear the lysate.

F.4 Binding of DNA

9. **500 µL Binding Buffer PC** was added to each well of a Square-well Block.
    - The volume was increased by **250 µL** if extra PL1 was used.
10. The cleared lysate was transferred to the Square-well Block and mixed.

F.5 Transfer to Binding Plate

11. The lysate was transferred into the **NucleoSpin® Plant II Binding Plate** mounted on a vacuum manifold setup.
12. Vacuum was applied to bind DNA to the silica membrane (flow rate: 1–2 drops/second).

F.6 Washing Steps

- **1st Wash**: 400 µL Buffer PW1
- **2nd Wash**: 700 µL Buffer PW2
- **3rd Wash**: 700 µL Buffer PW2
- After each step, vacuum was applied until complete passage of the solution.

F.7 Drying

13. The binding plate was transferred to a new MN Square-well Block.
14. The plate was sealed with gas-permeable foil and centrifuged at **6,000 × g for 10 min**.

F.8 DNA Elution

15. **50 µL preheated Buffer PE (70°C)** was added to each well. After **5 min incubation at room temperature**, the plate was centrifuged at **6,000 × g for 2 min**.
16. The elution was repeated with another **50 µL Buffer PE** and centrifuged again.
17. Final eluates were collected for DNA quantification and downstream applications.

F.9 Dilution for qPCR

18. DNA was diluted **1:10** by adding **10 µL DNA** to **90 µL molecular-grade water** in a new PCR plate for quantification and qPCR use.

Appendix G: Quantitative PCR (qPCR) Protocol

Quantitative PCR (qPCR) was used to assess the abundance of arbuscular mycorrhizal fungal (AMF) DNA in root samples, using a SYBR-based detection system with EvaGreen® dye.

G.1 qPCR Setup

Reactions were prepared in 384-well plates using the **CFX Opus 384 Real-Time PCR System** (Bio-Rad). The master mix for each 10 µL reaction was composed as follows:

Component	Final conc.	Volume per well
5× HOT FIREPol® EvaGreen® Mix Plus	1×	2.0 µL
F-primer (AMG1F, 10 µM)	500 nM	0.5 µL
R-primer (AM1, 10 µM)	500 nM	0.5 µL
Molecular-grade water	—	5.0 µL
Template DNA (2 ng/µL)	2 ng	2.0 µL
Total volume	—	**10 µL**

Each sample was run in **technical duplicates**, and a negative control (NTC) was included for each primer set.

G.2 Thermal Cycling Conditions

The qPCR amplification protocol used was:

1. **Initial Denaturation**: 95 °C for 15 minutes
2. **Amplification (40 cycles)**
   - Denaturation: 95 °C for 15 s
   - Annealing: 58 °C for 20 s
   - Extension: 72 °C for 30 s
3. **Melting Curve Analysis**:
   - 65–95 °C in 0.5 °C increments every 5 s

Fluorescence was recorded at the end of each extension phase and during the melting curve to verify specificity.

G.3 Plate Setup and Sample Preparation

- A dilution of **1:10** was used for each extracted DNA sample.
- Reactions were arranged in a 96-sample layout per plate, following a consistent template map.
- Master mix and DNA were pipetted using a **pipetmaX® system** or multichannel pipette for consistency.

Appendix H: PTW chemical informations

Tabelle 1: Chemical reactions occurring during the generation of plasma-activated water (PAW), resulting in the formation of reactive oxygen and nitrogen species (ROS/RNS). Source: Pârvulescu, V. I., Magureanu, M., & Lukes, P. (2012). Plasma chemistry and catalys

Reaction No.	Reaction Equation
1	$H_2O + e^- \rightarrow \cdot OH + H^+ + e^-$
2	$H_2O + e^- \rightarrow H^+ + \cdot OH^- + 2\ e^-$
3	$H_2O + e^- \rightarrow H\cdot + O\cdot + H\cdot + e^-$
4	$O_2 + e^- \rightarrow O^+ + O^- + 2\ e^-$
5	$O_2 + e^- \rightarrow O^- + O$
6	$O + O_2 \rightarrow O_3$
7	$O_3 + NO \rightarrow NO_2 + O_2$
8	$N + O_2 \rightarrow NO + O$
9	$O + N_2 \rightarrow NO + N$
10	$O + NO_2 \rightarrow NO + O_2$
11	$2\ NO + O_2 \rightarrow 2\ NO_2$
12	$NO_2 + \cdot OH \rightarrow HNO_3$
13	$H_2O_2 + hv \rightarrow \cdot OH + \cdot OH^-$
14	$3\ NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$
15	$H_2O_2 + H^+ + NO_2^- \rightarrow ONOOH + H_2O$
16	$\cdot OH^- + \cdot OH^- \rightarrow H_2O_2$
17	$NO + NO \rightarrow N_2 + O_2$
18	$NO + \cdot OH \rightarrow HNO_2$
19	$HNO_2 + \cdot OH \rightarrow NO_2^- + H_2O$
20	$NO_2^- + hv \rightarrow NO + O^-$
21	$NO_3^- + hv \rightarrow NO + O_2$
22	$NO_2 + NO_3 \rightarrow N_2O_5$
23	$N_2O_5 + H_2O \rightarrow 2\ HNO_3$
24	$2\ NO_2 + H_2O \rightarrow NO_2^- + NO_3^- + 2\ H^+$
25	$3\ NO_2^- + 3\ H^+ \rightarrow 2\ NO + NO_3^- + H_3O^+$
26	$OH^- + NO_2 \rightarrow [O{=}N\text{-}OOH] \rightarrow O{=}N\text{-}OO^- + H^+$

Reference: Pârvulescu, V. I., Magureanu, M., & Lukes, P. (2012). Plasma chemistry and catalysis in gases and liquids. John Wiley & Sons.