
Contents

Contents	I
Abbreviations.....	III
Abstract	1
Zusammenfassung.....	2
1 Introduction.....	3
1.1 The mycorrhiza provides a strong C-sink in roots	3
1.2 The shikimate pathway, an interface between carbon and nitrogen metabolism	5
1.3 Ozone alters carbon flow.....	9
1.4 Systemic effects of ozone and mycorrhization	11
1.5 Goal of this work.....	12
2 Material and Methods.....	13
2.1 Technical equipment	13
2.2 Chemicals and enzymes	14
2.3 Organisms	15
2.4 Plant cultivation and growth conditions	16
2.4.1 Marigold cultivation and inoculum production.....	16
2.4.2 Tomato pre-cultivation	17
2.5 Experimental setup and harvest.....	17
2.5.1 Splitroot experiments: mycorrhization	18
2.5.2 Single pot experiments: ozone	19
2.5.3 Single pot experiments: mycorrhization and ozone	20
2.6 Determination of mycorrhization rate	21
2.7 Metabolite analysis.....	22
2.7.1 Element analysis	22
2.7.2 Concentrations of sugar, starch and chlorophyll	22
2.7.3 Glutathione assay.....	24
2.8 Emissions of volatile organic compounds (VOCs)	26
2.9 Molecular biological techniques	28
2.9.1 RNA isolation from plant material	28
2.9.2 Isolation of bacterial plasmid DNA.....	30
2.9.3 cDNA synthesis	30
2.9.4 Ligation	30
2.9.5 Determination of nucleic acid concentration.....	30
2.9.6 Gelelectrophoresis.....	31
2.9.7 Northernblot.....	31

2.9.8 Hybridisation and immunological detection	32
2.9.9 Recombinant plasmids	32
2.9.10 PCR reaction	34
2.9.11 Specificity of the probes	35
2.9.12 Microbiological methods	36
2.9.12.1 Growth conditions and cultivation of <i>E. coli</i>	36
2.9.12.2 Competent cells and transformation	36
3 Results	37
3.1 Biomasses	39
3.2 Elements	42
3.3 Sugar and starch	51
3.4 Changes in shikimate pathway transcripts due to mycorrhization	54
3.5 Glutathione	59
3.6 Changes in Shikimate pathway transcripts due to ozone fumigation	61
3.7 Systemic changes in the plant response to ozone, affected by mycorrhization	63
3.7.1 Changes in VOC emissions due to mycorrhization	63
3.7.2 Shikimate pathway transcripts	67
3.7.3 Carbohydrates	71
3.7.4 Glutathione	71
4 Discussion	73
4.1 Local and systemic changes in physiology of the tomato - <i>Glomus intraradices</i> symbiosis	73
4.1.1 Growth depression in mycorrhizal plants	74
4.1.2 Better nutrient acquisition due to VAM fungi	76
4.1.3 Changes in carbon and carbohydrates concentrations due to VAM fungi	80
4.2 Defence and stress response are affected by mycorrhization	82
4.2.1 Defence reactions and signalling in mycorrhizal symbiosis	83
4.2.2 Influence of ozone on shikimate pathway transcription	86
4.2.3 Mycorrhization affects stress responses induced by ozone	88
5 Outlook	91
References	92
List of Figures	102
List of Tables	104
Danksagung	105