

## Contents

Contents .....	I
List of tables .....	IV
List of figures .....	IX
Abbreviations and definitions .....	XII
1. Introduction .....	1
2. Hypothesis .....	4
3. Literature review .....	5
3.1 Botany of Anise .....	5
Taxonomy of <i>Pimpinella anisum</i> L. ....	5
Morphological characteristics .....	5
3.2 Cultivation of anise .....	6
3.3 Weeds, insect, pests and diseases .....	7
3.4 Essential oil .....	9
3.4.1 Chemical composition .....	10
3.4.2 Biosynthesis of terpenes .....	11
3.5 Physiological effects and application of anise .....	13
Medicinal and pharmacological properties .....	13
4. Materials and methods .....	16
4.1 Overview of field experiments .....	16
4.2 Soil conditions .....	16
Experimental station Gross-Gerau .....	16
Fertilization .....	17
Irrigation schedule .....	18
Plant protection .....	18
Experimental station Giessen .....	19
Soil analyses and fertilization .....	19
Plant protection .....	20
4.3 Climate conditions .....	20
Experimental station Gross-Gerau 2008-2010 .....	20
Experimental station Giessen 2008-2009 .....	21
4.4 Description of the experiments .....	22
4.4.1 Cultivars/seed rate experiments in two sowing times .....	22
Design of the experiment .....	22
Study parameters .....	22
Disease severity (1-9) .....	23
4.4.2. Row spacing/seed rate experiment .....	24
Design of the experiment .....	24
Study parameters .....	24
4.4.3. Fungicide experiments .....	26
Design of the experiment .....	26

Study parameters .....	27
4.5. Lab analysis .....	28
Water steam distillation .....	28
GC and GC-MS analysis .....	29
Preparation of standard solutions for the determination of essential oil components.....	30
Gas-chromatography.....	30
GC-MS .....	33
4.6. Statistical analyses.....	36
5. Results.....	37
5.1 Effect of different sowing times, plant densities and cultivars .....	37
5.1.1 Field experiment Gross-Gerau 2008 .....	37
5.1.1.1 Disease and lodging assessment .....	37
5.1.1.2 Growth and fruit yield parameters.....	38
5.1.1.3 Content, yield and composition of essential oil .....	42
5.1.2 Field experiment Gross-Gerau-2009 .....	44
5.1.2.1 Disease and lodging assessment .....	44
5.1.2.2 Growth and fruit yield parameters.....	45
5.1.2.3 Content, yield and composition of essential oil .....	47
5.1.3 Field experiment Giessen 2008 .....	51
5.1.3.1 Disease assessment.....	51
5.1.3.2 Growth and fruit yield parameters.....	51
5.1.3.3 Content, yield and composition of essential oil .....	55
5.1.4 Field experiments Giessen 2009 .....	56
5.1.4.1 Disease and lodging assessment .....	56
5.1.4.2 Growth and fruit yield parameters.....	58
5.1.4.3 Content, yield and composition of essential oil .....	60
5.2 Effect of different row spacing and plant densities .....	64
5.2.1 Field experiments Gross-Gerau 2008-2009 .....	64
5.2.1.1 Disease assessment.....	64
5.2.1.2 Growth and fruit yield parameters.....	65
5.2.1.3 Content, yield and composition of essential oil .....	67
5.2.2 Field experiments Giessen 2008-2009 .....	70
5.2.2.1 Disease and lodging assessment .....	70
5.2.2.2 Growth and fruit yield parameters.....	71
5.2.2.3 Content, yield and composition of essential oil .....	73
5.3 Effect of fungicide application .....	75
5.3.1 Field experiment Gross-Gerau 2009 .....	75
5.3.1.1 Disease and lodging assessment .....	75

5.3.1.2 Growth and fruit yield parameters .....	78
5.3.1.3 Content, yield and composition of essential oil .....	80
5.3.2 Fungicide experiment Gross Gerau 2010 .....	84
5.3.2.1 Disease and lodging assessment .....	84
5.3.2.2 Growth and fruit yield parameters .....	86
5.3.2.3 Content, yield and composition of essential oil .....	89
6. Discussion .....	92
6.1 Effect of cultivar, plant density and sowing time .....	92
6.1.1 Fruit yield and yield components .....	92
6.1.2 Content and yield of essential oil .....	95
6.1.3 Chemical composition of essential oil .....	96
6.2 Effect of row spacing and plant density .....	98
6.2.1 Fruit yield and yield components .....	98
6.2.2 Content and yield of essential oil .....	101
6.2.3 Chemical composition of essential oil .....	102
6.3 Fungicides and cultivars .....	104
6.3.1 Impact of fungicides on plant growth and fruit yield .....	104
6.3.2 Essential oil synthesis and yield .....	106
6.3.3 Essential oil composition .....	107
7. Summary .....	109
8. Zusammenfassung .....	111
9. Reference .....	113
10. Appendices .....	124
Declaration / Erklärung .....	111
Acknowledgements .....	112