# TABLE OF CONTENTS

**ABBREVIATIONS** ..... **III**

**ABSTRACT** ..... **IV**

**1 INTRODUCTION** ..... **1**

1.1 BOTANY AND ECOLOGY ..... 1
1.2 ORIGIN AND REGIONS OF CULTIVATION OF COWPEA ..... 1
1.3 DROUGHT/WATER DEFICIT IN COWPEA ..... 3
1.4 STATE OF RESEARCH IN PHYSIOLOGY AND GENETICS OF COWPEA DROUGHT ADAPTATION ..... 6
1.5 STATEMENT OF PROBLEM ..... 8
1.6 OBJECTIVES OF THE PRESENT STUDY ..... 9

**2 MATERIALS AND METHODS** ..... **10**

2.1 PLANT MATERIAL. ..... 10
2.2 IRRIGATION SYSTEM ..... 11
2.3 GROWTH CONDITIONS ..... 13
*2.3.1 Phytotron* ..... *13*
*2.3.2 Pots and growth substrate* ..... *13*
*2.3.3 Fertilization* ..... *15*
2.4 EXPERIMENTAL METHODS ..... 17
*2.4.1 Experiment 1* ..... *17*
*2.4.2 Experiment 2* ..... *18*
*2.4.3 Sampling/Data collection* ..... *19*
2.5 MEASUREMENT OF GAS EXCHANGE ..... 20
2.6 MEASUREMENT OF LEAF WATER POTENTIAL ..... 20
2.7 DETERMINATION OF RELATIVE WATER CONTENT (RWC) ..... 21
2.8 MEASUREMENT OF LEAF AREA ..... 22
2.9 DETERMINATION OF NITROGEN CONTENT BY KJELDAHL METHOD ..... 22
2.10 STATISTICAL ANALYSIS ..... 22

**3 RESULTS** ..... **24**

3.1 CROP DEVELOPMENT ..... 24
3.2 WATER RELATION ..... 27
*3.2.1 Soil water potential* ..... *27*
*3.2.2 Water use* ..... *28*
*3.2.3 Water use efficiency (WUE)* ..... *31*
*3.2.4 Leaf water potential* ..... *34*
*3.2.5 Relative water content of leaves (RWC)* ..... *37*
3.3 GAS EXCHANGE ..... 38
*3.3.1 Assimilation rate (A)* ..... *38*

*3.3.2 Transpiration rate (E)* ..... *42*
*3.3.3 Stomata conductance for $CO_2$ ($gCO_2$)* ..... *44*
*3.3.4 Internal $CO_2$ concentration ($C_i$)* ..... *48*
*3.3.5 Instantaneous water use efficiency (IWUE)* ..... *51*
3.4 DRY MATTER PARTITIONING ..... 54
*3.4.1 Dry matter partitioning at flowering (BS)* ..... *54*
*3.4.2 Dry matter partitioning at end of water stress (SE)* ..... *56*
*3.4.3 Dry matter partitioning at maturity* ..... *59*
*3.4.4 Yield and yield components* ..... *61*
*3.4.5 Leaf nitrogen and Seed quality* ..... *69*
3.5 RELATIONSHIP BETWEEN PARAMETERS DURING WATER STRESS ..... 70

**4 DISCUSSION ..... 73**

4.1 WATER USE AND DRY MATTER ACCUMULATION AND PARTITIONING ..... 73
4.2 PLANT WATER STATUS AND GAS EXCHANGE PARAMETERS ..... 80
4.3 YIELD AND YIELD COMPONENTS ..... 83
4.4 NITROGEN CONTENT AND WATER STRESS ..... 87
4.5 STRATEGY OF DROUGHT RESISTANCE ..... 89

**5 CONCLUSION ..... 92**

**6 ZUSAMMENFASSUNG ..... 95**

**7 REFERENCES ..... 97**

**LIST OF FIGURES ..... 109**

**LIST OF TABLES ..... 112**

**LIST OF TABLES IN APPENDIX ..... 114**

**APPENDIX ..... 115**