

Índice

| | |
|---|-----------|
| Capítulo 1..... | 1 |
| Introducción | 1 |
| 1.1.Aspectos generales del cultivo del pimiento..... | 2 |
| 1.1.1. Taxonomía y descripción botánica | 2 |
| 1.1.2. Importancia económica del cultivo del pimiento..... | 2 |
| 1.1.3. Propiedades organolépticas y nutraceuticas del fruto de pimiento | 3 |
| 1.1.4. Principales fisiopatías del fruto de pimiento..... | 4 |
| 1.1.4.1. Blossom-end rot (BER)..... | 4 |
| 1.1.4.2. Rajado o micro rajado del fruto | 4 |
| 1.2.Principales problemas del cultivo del pimiento | 4 |
| 1.2.1. Estrés bióticos | 5 |
| 1.2.2. Estrés abióticos | 5 |
| 1.2.2.1. Estrés térmico por altas temperaturas | 6 |
| 1.2.2.2. Estrés hídrico | 7 |
| 1.2.2.3. Otros estrés abióticos importantes en el cultivo del pimiento .. | 9 |
| 1.3.Técnica del injerto. Herramienta para hacer frente estrés abióticos..... | 10 |
| 1.3.1. Uso del injerto en el cultivo del pimiento | 12 |
| 1.4.Objetivos de la tesis | 13 |
| 1.5.Bibliografía | 16 |
| | |
| Capítulo 2..... | 28 |
| Suitable rootstocks can alleviate the effects of heat stress on pepper plants | 28 |
| 2.1.Abstract | 29 |
| 2.2.Introduction..... | 30 |
| 2.3.Materials and methods | 33 |
| 2.3.1. Experiment 1: Physiological behaviour of pepper plants under the control and heat stress conditions of growth chambers | 33 |
| 2.3.2. Experiment 2: Agronomic evaluation of the pepper grafted plants under heat stress conditions in a greenhouse | 35 |
| 2.3.3. Statistical analysis of data | 38 |
| 2.4.Results | 39 |
| 2.4.1. Experiment 1: Physiological behaviour of pepper plants under the control and heat stress conditions in growth chambers | 39 |
| 2.4.1.1. Relative growth rate | 39 |
| 2.4.1.2. Leaf area | 39 |
| 2.4.1.3. Electrolyte leakage | 40 |
| 2.4.1.4. Chlorophyll a fluorescence | 41 |
| 2.4.1.5. Heat Shock Proteins | 43 |

| | |
|--|-----------|
| 2.4.1.6. Multiple regression analysis | 44 |
| 2.4.2. Experiment 2: Agronomic evaluation of pepper grafted plants under the heat stress conditions in greenhouses | 44 |
| 2.5. Discussion | 48 |
| 2.6. Conclusions..... | 52 |
| 2.7. References | 53 |
| | |
| Capítulo 3..... | 61 |
| Rootstock-mediated physiological and fruit set responses in pepper under heat stress | 61 |
| 3.1. Abstract | 62 |
| 3.2. Introduction..... | 63 |
| 3.3. Materials and methods | 66 |
| 3.3.1. Plant material and growth conditions..... | 66 |
| 3.3.2. Experiment 1 (2020): rootstocks’ influence on pepper physiological aspects under heat stress | 67 |
| 3.3.2.1. Electrolyte leakage | 67 |
| 3.3.2.2. Chlorophyll and carotenoids concentration..... | 67 |
| 3.3.2.3. Ascorbate metabolism | 68 |
| 3.3.2.4. Total phenolic content | 68 |
| 3.3.2.5. Hydrogen peroxide quantification | 68 |
| 3.3.3. Experiment 2 (2021): rootstocks’ influence on pepper fruit set components under heat stress | 69 |
| 3.3.3.1. <i>In vitro</i> germination of the pollen grain percentage (%)..... | 69 |
| 3.3.3.2. Primary metabolites analysis from anthers | 69 |
| 3.3.3.3. Biomass production..... | 70 |
| 3.3.4. Statistical Analysis | 70 |
| 3.4. Results | 71 |
| 3.4.1. Experiment 1: rootstocks’ influence on pepper physiological aspects under heat stress | 71 |
| 3.4.1.1. Electrolyte leakage | 71 |
| 3.4.1.2. Chlorophyll and carotenoids concentration..... | 71 |
| 3.4.1.3. Ascorbate and dehydroascorbate concentration | 72 |
| 3.4.1.4. Total phenolic content | 75 |
| 3.4.1.5. Hydrogen peroxide quantification | 75 |
| 3.4.1.6. Fruit set percentage | 76 |
| 3.4.2. Experiment 2: rootstocks’ influence on pepper fruit set components under heat stress | 76 |
| 3.4.2.1. <i>In vitro</i> germination of pollen grain percentage | 76 |
| 3.4.2.2. Primary metabolites analysis from anthers | 77 |
| 3.4.2.3. Fruit set percentage | 78 |
| 3.4.2.4. Number of seeds per fruit | 78 |

| | |
|---|------------|
| 3.4.2.5. Biomass production..... | 81 |
| 3.5. Discussion..... | 82 |
| 3.6. Conclusions..... | 86 |
| 3.7. Supplementary materials..... | 87 |
| 3.8. References..... | 88 |
| | |
| Capítulo 4..... | 96 |
| Grafting onto an Appropriate Rootstock Reduces the Impact on Yield and Quality of Controlled Deficit Irrigated Pepper Crops..... | 96 |
| 4.1. Abstract..... | 97 |
| 4.2. Introduction..... | 98 |
| 4.3. Materials and methods..... | 100 |
| 4.3.1. Experimental Site..... | 100 |
| 4.3.2. Plant Material..... | 100 |
| 4.3.3. Irrigation Strategies..... | 101 |
| 4.3.4. Soil Moisture..... | 102 |
| 4.3.5. Physiological Measurements..... | 103 |
| 4.3.6. Biomass and Fruit Yield..... | 104 |
| 4.3.7. Statistical Analysis..... | 104 |
| 4.4. Results..... | 105 |
| 4.4.1. Soil Moisture..... | 105 |
| 4.4.2. Plant Water Relations..... | 106 |
| 4.4.3. Photosynthetic Parameters..... | 109 |
| 4.4.4. Plant Biomass and Fruit Yield..... | 111 |
| 4.5. Discussion..... | 116 |
| 4.6. Conclusions..... | 119 |
| 4.7. Supplementary materials..... | 120 |
| 4.8. References..... | 122 |
| | |
| Capítulo 5..... | 127 |
| A Water Stress–Tolerant Pepper Rootstock Improves the Behavior of Pepper Plants under Deficit Irrigation through Root Biomass Distribution and Physiological Adaptation..... | 127 |
| 5.1. Abstract..... | 128 |
| 5.2. Introduction..... | 129 |
| 5.3. Materials and methods..... | 130 |
| 5.3.1. Growth Conditions..... | 130 |
| 5.3.2. Plant Material..... | 130 |
| 5.3.3. Irrigation Management and Control..... | 130 |

| | |
|---|------------|
| 5.3.4. Physiological Parameters..... | 131 |
| 5.3.5. Production Parameters..... | 131 |
| 5.3.6. Biomass Parameters | 131 |
| 5.3.7. Experimental Design and Statistical Analysis | 132 |
| 5.4. Results | 133 |
| 5.4.1. Irrigation Management | 133 |
| 5.4.2. Physiological Parameters..... | 133 |
| 5.4.3. Production Parameters..... | 135 |
| 5.4.4. Biomass Parameters | 136 |
| 5.5. Discussion | 139 |
| 5.6. Conclusions..... | 142 |
| 5.7. Supplementary materials | 143 |
| 5.8. References | 144 |
| | |
| Capítulo 6..... | 148 |
| Effect of Grafting on the Production, Physico-Chemical Characteristics and Nutritional Quality of Fruit from Pepper Landraces..... | 148 |
| 6.1. Abstract | 149 |
| 6.2. Introduction..... | 150 |
| 6.3. Materials and methods | 152 |
| 6.3.1. Plant Material | 152 |
| 6.3.2. Soil-Field Experiment..... | 152 |
| 6.3.3. Fruit Yield and Quality Assessment | 152 |
| 6.3.4. Fruit Dry Material and Pulp Thickness..... | 153 |
| 6.3.5. Fruit Color Index Determination..... | 153 |
| 6.3.6. Titratable Acidity | 153 |
| 6.3.7. Total Phenolic Analysis and Antioxidant Capacity Measurements | 153 |
| 6.3.8. Ascorbic Acid Concentration | 154 |
| 6.3.9. Chlorophyll and Carotenoids Concentration | 154 |
| 6.3.10. Lycopene Concentration..... | 154 |
| 6.3.11. Volatiles Organic Compound Analysis | 155 |
| 6.3.12. Statistical Analysis | 156 |
| 6.4. Results | 158 |
| 6.4.1. Fruit Yield..... | 158 |
| 6.4.2. Fruit Physico-Chemical Characteristics..... | 159 |
| 6.4.3. Nutraceutical Compounds and Antioxidant Capacity | 161 |
| 6.4.4. Volatile Compounds | 166 |
| 6.5. Discussion | 172 |
| 6.6. Conclusions..... | 177 |
| 6.7. References | 178 |

| | |
|--|------------|
| Capítulo 7..... | 187 |
| Discusión General | 187 |
| 7.1. Uso de la técnica del injerto para hacer frente al estrés térmico..... | 188 |
| 7.2. Uso de la técnica del injerto para hacer frente al estrés hídrico | 192 |
| 7.3. Efecto del injerto sobre el rendimiento y calidad de variedades tradicionales | 195 |
| 7.4. Bibliografía | 198 |
| Capítulo 8..... | 204 |
| Conclusión general | 204 |