Protected cultivation

Construction, requirements and use of greenhouses in various climates
Protected cultivation

Construction, requirements and use of greenhouses in various climates

Ernst van Heurn
Kees van der Post
Foreword

This Agrodok deals with the possibilities applicable to protect horticultural crops against unfavorable climatic conditions. It fits with the worldwide expansion of tunnels and greenhouses covered with plastic foils during the last two or three decades.

The development of sophisticated construction and climate control techniques justifies explanations on the more basic level. This Agrodok hopes to fulfill this target.

The writers are indebted to several reviewers, who offer valuable and helpful suggestions. Special acknowledgement is made to Dries Waayenberg of the Institute of Agricultural and Environmental Engineering (IMAG – DLO, Wageningen) and to Frits Veenman of Royal Brinkman B.V. in ‘s Gravenzande, for their valuable and constructive contributions, their criticizing, and suggestions to amplify the text.

We sincerely hope that this Agrodok will contribute to a worldwide development of intensive horticulture and will benefit a broad diversity of advisors and entrepreneurs.

The authors
Contents

1  Introduction 6

2  Requirements for greenhouse cultivation 8
   2.1  Introduction 8
   2.2  Point of departure when starting a greenhouse project 8
   2.3  Recording of the climate 9
   2.4  Other requirements for intensive cultivation 15
   2.5  Topography of the land 18
   2.6  Spatial infrastructure and distribution 18

3  Greenhouses: types and constructions 19
   3.1  Introduction 19
   3.2  Low constructions 19
   3.3  Low tunnels 21
   3.4  Walk-in-tunnels 22
   3.5  Tunnels with opportunities for climate regulation 23
   3.6  Shade halls 26

4  Greenhouse cover 28
   4.1  Introduction 28
   4.2  Cover of plastic film 28
   4.3  Effects of the cover materials 30

5  Climate control in the greenhouse 32
   5.1  Introduction 32
   5.2  Methods to regulate the climate 32
   5.3  Integration of the different elements of Climate Control 44
   5.4  Reactions of the crop to regulation of the climate 49

6  Water supply and crop protection 50
   6.1  Introduction 50
   6.2  Water supply and fertilising 50
   6.3  Methods of supplying water to the crop 53
### Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4</td>
<td>Disease control</td>
<td>55</td>
</tr>
<tr>
<td>6.5</td>
<td>Spaces for storage and preservation</td>
<td>57</td>
</tr>
<tr>
<td>6.6</td>
<td>Necessary instruments and tools</td>
<td>58</td>
</tr>
<tr>
<td>7</td>
<td><strong>Crop selection, care, labour and yield</strong></td>
<td>61</td>
</tr>
<tr>
<td>7.1</td>
<td>Introduction</td>
<td>61</td>
</tr>
<tr>
<td>7.2</td>
<td>Crops for different types of greenhouses</td>
<td>61</td>
</tr>
<tr>
<td>7.3</td>
<td>Crop care</td>
<td>62</td>
</tr>
<tr>
<td>7.4</td>
<td>Labour intensiveness</td>
<td>66</td>
</tr>
<tr>
<td>7.5</td>
<td>Financial turnover</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td><strong>Appendix: Climate tables</strong></td>
<td>69</td>
</tr>
<tr>
<td></td>
<td><strong>Further reading</strong></td>
<td>74</td>
</tr>
<tr>
<td></td>
<td><strong>Useful addresses</strong></td>
<td>76</td>
</tr>
<tr>
<td></td>
<td><strong>Glossary</strong></td>
<td>80</td>
</tr>
</tbody>
</table>
1 Introduction

The demand for an Agrodok on greenhouse cultures came from communities of farmers and market gardeners with small enterprises. Their need mainly concerns simple solutions to protect their crops using plastic film, in (sub)tropical countries as well as in the cooler mountainous regions of Africa and South America. We hope that this Agrodok will furnish this need.

In the near future, film will be used more and more and in very many forms too. It will mean that with little investments, farmers and market gardeners will soon be able to work more intensively and efficiently. This will enhance their cropping programme and the quality of their crops so that they can get a better market value for their products and, furthermore, reduce climatic risks.

People have always protected their crops from unfavourable climatic effects, from time immemorial. Shrubs and walls protect against the wind, foliage and slats against harsh sunlight and driving rain, and glass against the cold. The centuries-old practice in Europe of cultivation under glass placed at a 60° angle against a wall, can still be found in China near Peking. A similar sight can be seen in the highlands of Bolivia, where loam walls and plastic film shields at the sunside.

Glass is the material that has been used through the ages to let light into a greenhouse. The discovery of transparent synthetic film was a groundbreaking development. It made the building of a greenhouse very much cheaper. Since recent decades in many countries greenhouses and tunnels covered with plastic film are present. Indeed huge greenhouse complexes have sprung up in the highlands of East Africa and in the Andes region of South America too. Affluent countries build and supervise these greenhouses and local farmers who had sold their land to these enterprises become part of the labour force. They actually do learn about cultivation in greenhouses and, therefore, might possibly want to do this themselves independently later on, but then in a greenhouse that they could afford.

What such a greenhouse should look like depends on the type of climate. Should the crops be protected against the cold or also against
strong sun’s rays? What should the ventilation capacity be or will a shade covering be the solution? Briefly, it is essential to first take into account the effects of the local climate when choosing a greenhouse and equipment. This is why we will start with a description of some very different climatic conditions, after which types of greenhouses and their constructions will be dealt with in subsequent chapters, together with regulation of the most appropriate greenhouse climate.