

Protected Agriculture in the Republic of Yemen

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Abstract

By the end of 1997, there were about 2000 plastic houses in Yemen (mainly in the highlands), run by farmers (95%), private sector (4%) and public-sector cooperatives (the remainder). Most greenhouses in Yemen are single-span types with galvanized iron frames. They are all plastic houses (mostly UV-resistant), and sizes vary between 6×54 m and 9×60 m. The most important crops grown under protected agriculture (PA) are cucumber (90%), tomato (5%), pepper and eggplant (5%); there are also a few floricultural greenhouses. Irrigation is either by drip system (promoted by national and international specialists)—with imported components, specially filters—or by surface system (for those who cannot afford to operate a drip system). Fertigation is managed by specialist technicians, but there is no standardization of chemicals applied (and their formulations), dosages or application methods. Plant diseases are generally controlled chemically. The promotion and development of PA is mainly in the hands of the Ministry of Agriculture and Irrigation and the private sector. The following constraints hinder the PA sector in Yemen: greenhouse design and structure (high temperatures in summer with poor ventilation, promoting fungal diseases); location of greenhouses; polyethylene cover is short-lived, prone to storm-damage and to condensation; hybrid seeds are expensive and cultivar import is unpredictable; farmers lack experience in chemical use, resulting in harmful residues in harvested vegetables; numerous problems with the PA infrastructure (e.g. shortage of trained personnel, insufficient research, lack of information, lack of an overall development plan for Yemeni PA).

Introduction

The Republic of Yemen is located in the south part of the Arabian Peninsula, between latitudes 12° and 20° N and longitudes 41° and 54° E. The country is bordered by Saudi Arabia to the north, the Arabian Sea and Gulf of Aden to the south, Oman to the east and the Red Sea to the west; the total area is 5.5 million hectares, with a human population of 16 million. The total arable land is about 1.7 million hectares, of which 1.2 million hectares is cultivated—54% is rain-fed, 37% irrigated by groundwater and the rest flood-irrigated.

Yemen has a predominantly semi-arid to arid climate. The variation in elevation causes differences in climate conditions, ranging from hot and humid on the coast to relatively cool and dry in the mountains, with moderate temperature and humidity on the plateaux.

The climate pattern should allow for year-round production of vegetables, but this is not possible because of the small and scattered patches of arable land, the limited water resources, the low yield per unit area, and the poor roads between the production areas and marketing centers.

Thus, to improve vegetable crops so that they can compete not only in local markets but also abroad, it is necessary to pay more attention to the quantity and quality of these crops along with natural-resources preservation—mostly water—with optimum utilization of cropped area. Protected agriculture is considered an important means of increasing the productivity and quality of most vegetable crops.

There has been an increase in interest in protected agriculture (PA) in Yemen, except in areas where its development and expansion are hindered by other factors. Such limiting factors include limited national experience in PA and lack of adoption potential by certain farmers (mainly due to the high cost of PA establishment). The demand for plastic houses has increased and their use has spread in some regions: where there were 20 protected houses belonging to four agri-research stations and others belonging to public-sector cooperatives, there were approximately 2000 plastic houses by the end of 1997—of which 95% belonged to farmers, 4% belonged to the private sector and the remainder belonged to public-sector cooperatives. These plastic houses are mainly located in highland regions (Dhamar, Sana'a, Sa'dah): no protected agriculture is practiced in the coastal region.

Average temperatures are principally affected by elevation. The difference between the average temperatures of the warmest and the coolest month of the year is not constant over agro-ecological zones. In the coastal, western and southern areas, it is generally less than 10°C, but in the arid interior it increases to about 15°C. Above 2300 m altitude frost occurs regularly between mid-October and March.

In the mountains, relative humidity varies between 30 and 60%, except in the high-rainfall areas where values between 50 and 70% are observed. In the arid interior values are below 40%.

Clear skies predominate in Yemen during most of the year. Annual average values are between 6 and 10 hours of sunshine per day. The net solar radiation per year is lowest in the coastal zone (below 5500 MJ/m² per year), somewhat higher in the high-rainfall areas (5200–6000 MJ/m² per year) and in the dry interior (5500–6000 MJ/m² per year), and highest (6000–6500 MJ/m² per year) in the mountains and inter-mountain plains.

Average wind-speed in most of Yemen is low to moderate (<1 to 2 m/s), except on the coast and at well-exposed locations in the mountains (2–2.5 m/s).

Protected Agriculture

Greenhouse Design

Most of the (sparsely spread) greenhouses in Yemen are single-span plastic houses formed of 21–24 arcs of galvanized iron water-pipes (diameter 3.8–5.1 cm, spaced at 2.5 m). The typical area of the greenhouse is 324–540 m², with dimensions of 6 × 54 m and 9 × 60 m, and height 3–3.5 m. Each house has two doors, whose design depends upon the financial resources of the owners.

The common type of plastic cover is a UV-resistant polyethylene sheet of 150–200 µm thickness, which is manufactured locally.

Significant Crops Grown under Protected Agriculture in Yemen

Cucumber forms 90% of the production in greenhouses, followed by tomato (5%). Other crops include pepper and eggplant (5%); and there are a few greenhouses which produce mainly floricultural crops.

Productivity and its Relation to the Protective System

The average production of cucumber and tomato under farmers' and some private-sector companies' conditions are shown in Table 1.

Table 1. Cucumber and tomato production in protected agriculture (two seasons per year) compared with open field (one season).

Crop	Protected agriculture		Open field (t/ha per year)
	Mean yield/season (t/ha)	Total yield (t/ha per year)	
Cucumber	130	260	15
Tomato	185	370	30

Table 1 shows that productivity under protected agriculture is higher than that in open field for the same crop. Cucumber productivity was 17-fold greater under PA, while that for tomato reaches 12-times its productivity in a non-protected system. This is what makes PA so economically important.

Greenhouse Management

Land is prepared according to the farmers' own experience and extension recommendations.

The soil is sterilized chemically using methyl bromide, chloropicrin, Basamide and Vydate. Sterilization is carried out under the supervision of a specialist; however, many farmers are not practicing soil sterilization because they are not aware of its importance.

Some farmers—particularly in Sa'dah and Sana'a governorates where there are many greenhouses—are skilled in pruning; in addition, there are some laborers trained in pruning in some private companies.

Several farmers use a drip irrigation system which was initiated by national and international specialists. Most of the materials for drip irrigation systems are imported, specially the filters, but the plastic pipes can be made locally. Generally there have been no experiments to determine the water-use efficiency and optimum water requirements for crops in the greenhouses. Recommendations are available from other practices and from experiments conducted in other countries with similar conditions.

A number of farmers use a surface irrigation system since they do not have the financial resources to install and manage a drip irrigation system.

Soluble fertilizers are often applied with the drip irrigation system or as foliar spray. This practice has been implemented and managed by technical cadres. However, there is wide variation in the chemicals used, their formulation, dosages used and methods of application.

The most common diseases in PA are downy and powdery mildews on cucumber, and fusarium on tomato. Viral diseases are not common except for leaf-curl virus on tomato. Arthropod pests comprise aphids, thrips, spider mites and white fly. Diseases are commonly chemically controlled.

Institutes Involved in Protected Agriculture in Yemen

The Ministry of Agriculture and Irrigation is the main supporter for PA in Yemen. The Ministry supports the industry by:

- making some raw materials available to the private sector and farmers;
- facilitating imports of agricultural materials , in particular seeds and fertilizer for PA.

The private sector plays a major role in adapting PA systems, i.e. establishing the greenhouses, and making the essential materials (seeds and fertilizer) available. In addition, the private sector plays a supervisory and extension role for some greenhouse growers.

In recent years, the Agricultural Research and Extension Authority (AREA) has supported PA by establishing relevant research and extension units. However, the capabilities of AREA are limited. AREA projects support and develop priority research activities to solve the present problems of farmers, but there is no source of support for its research activities in PA. The Arabian Peninsula Regional Program of the International Center for Agricultural Research in the Dry Areas has a mandate for PA, and may support research activities in AREA in the future.

Problems and Constraints of Protected Agriculture

A. Technical constraints

1. *Plastic-house structure design*: The current design has disadvantages of increased temperature during summer, which decreases ventilation and increases the humidity, leading to spread of fungal diseases.

2. Selection of an unsuitable *location for the plastic-house* structure—negatively affects the greenhouse and the crop.

3. *Problems of using plastic materials*

The life of plastic is short (1.5–2 years)

In heavy storms, the plastic material may be destroyed and this may lead to loss of the crops before the end of the season

Condensation of water vapor on the internal walls of the plastic house leads to:

- (a) reduced penetration of light
- (b) dropping of water on the plants, which damages them.

4. *Seed problems*

The price of hybrid seed is very high



The farmers have difficulties in selecting good cultivars owing to the absence of cultivar screening and evaluation.

No local production of hybrid cultivars.

5. *Constraints related to chemical use*: Farmers' lack of experience in using chemicals under PA leads to several problems such as residual effects on human, plant and environment health.

B. Management and research constraints

1. *Shortage of trained personnel* (i.e. growers, workers and national specialists), including within research cadres; consequently, no extension and training program for growers.

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2. *Lack of technical supervision on PA.*
 3. *Lack of baseline information.*
 4. *Insufficient scientific research in PA.*
 5. *Lack of research units for PA in different ecological zones; thus, lack of research and extension recommendations for cultivars, water-use efficiency, optimum water requirement and fertigation.*
 6. *Inadequate plant protection methods.*
 7. *Marketing problems.*
 8. *Inadequate storage and transportation.*
 9. *Lack of an overall development plan for the PA system in Yemen.*
 10. *No exchange of information with other Arabian Peninsula countries.*