Protected Agriculture in the State of Bahrain

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Abstract

Protected agriculture (PA) was introduced into Bahrain in 1976 and by 1996 the total area under protected cultivation was 59.5 ha. Interest in PA among farmers, and investors is increasing. The greenhouses used are plastic tunnels, the commonest being high (2.5–3 m) single-span tunnels, 36–40 m long. Humidity is a serious problem, specially from March onwards. Ventilation area is about 10% comprising openings in the tunnels sides, sometimes with electric fans. Fan-and-pad cooling has also been used, but is inefficient in the hot and dry Bahrain climate. Shading (25–50%) is often used in March, after removal of the plastic covering. This reduces inside temperature, but exposes crops to white fly. The inefficiency of cooling systems is the major constraint in PA in Bahrain. The main PA crops are tomato and cucumber, and both are pruned. Drip irrigation works well in PA in Bahrain. Ground-mulching with black polyethylene film is commonly practised. Soil solarization is used to control soil pests for short-season vegetables; otherwise pest control is chemical. Weeds are controlled by weeding, but those outside the greenhouse are essentially ignored. Research and extension have covered cultivar selection, drip irrigation, ground-mulching, planting date, shading, plant density, fertigation, pruning and cropping patterns. Current constraints to PA development include high cost of inputs, lack of skilled staff, pests and diseases, marketing, and lack of crop diversity. The following are needed to help Bahrainian PA progress: better designs for land-use efficiency; improved cooling; soilless techniques; integrated and biological pest control; improved water-use efficiency; diversification of crops adapted to the environment.

Introduction

Despite limited land and water resources and constraints of climatic conditions, the Government of Bahrain has been encouraging agricultural development in both public and private sectors by providing various facilities, and strengthening research and extension activities. This comes within the government's long-range aims of achieving a higher level of self-sufficiency in various agricultural products and in particular high-quality fresh vegetable crops.

Protected agriculture was introduced in Bahrain in 1976, and significant changes in the total area of greenhouse vegetable production have occurred. The total area under cultivation was 59.46 ha in 1996. An increasing number of farmers are now attracted to this new system of intensified cropping. Other investors with capital and land are also becoming interested. We have also been encouraged by the tremendous achievements realized in almost all neighboring countries, where self-sufficiency and even surplus of certain crops for export have been reported.

Structure and Covers Used

The structures used for protected vegetable production in the country include low, medium and high walk-in tunnels (usually called plastic houses), erected as single-spans, with frames made of galvanized steel pipes about 22 mm in diameter, aluminum or coated steel pipes. The dominant structures are high single-span plastic tunnels, 4–5 m wide, 2.5–3 m high and 36–40 m long (total surface area 140–180 m²). The cover for tunnels is imported or locally manufactured plastic film of different width and lengths, with a thickness ranging from 38 µm for low tunnels to 250 µm for walk-in tunnels and with ultraviolet-ray inhibitor (UVI) to increase its durability (2–3 years).

Ventilation, Shading and Cooling

Humidity is a major problem in the greenhouse. Large quantities of water are transpired through the leaves and evaporate from the soil and the water vapor cannot escape. This results in high humidity levels, creating optimal conditions for infection by and proliferation of fungal and bacterial diseases. Ventilation is achieved by openings in tunnel sides, but is often insufficient to prevent high humidity; this problem is aggravated towards the end of the season (March onwards) when the outside temperature increases. At the present time, ventilation areas are about 10%. There are some thoughts of including vents in the roof so that hot air can escape by normal upward convection. Electric fans are sometimes used to improve ventilation.

We have taken to removing the plastic film cladding from greenhouses in March and covering the frame with shade net cover giving 25 to 50% shading. This reduces the temperature inside the house as a result of heat reflection and reduced light intensity. Shading has also been useful for the early production of vegetable seedlings from August to September and for extending the season of some vegetables in the open field. However, shading does not protect the crop from white fly. No doubt, potential crop yield and quality would improve by using white-fly-proof clear fine mesh.

The traditional fan-and-pad cooling system was introduced to extend the season of vegetable production through the hot summer. Unfortunately, the system loses its efficiency under the extremely high temperatures and high

relative humidity prevailing in the country. The lack of an efficient and economical cooling system continues to be a major constraint facing the development of protected agriculture.

Participants discussing the production of cut-flower roses in open soilless system of sandbags, Ottoria Research Station (Qatar)

Cultivars

Many productive hybrids of various vegetables have been introduced and evaluated under local conditions, with emphasis on salt and disease resistance.

Cultural Practices

Drip irrigation performs well under the prevailing water and soil conditions. Crop rotation has not received adequate consideration. The main vegetable crops produced under protected agriculture are tomato and cucumber. Pepper, squash, snake cucumber, eggplant, lettuce, strawberry, bean and cut flowers have been introduced on a small scale.

Ground-mulching with black polyethylene film is a common practice. It significantly reduces water evaporation, raises soil temperature, eliminates weeds, prevents salt accumulation around the plants, and leads plants to early production.

Pruning of tomato and cucumber under plastic is practised. Organic and chemical fertilizers and composts have been used. Experimental stations apply chemical fertilizers through irrigation systems and as foliar sprays.

Vegetables grown under protected agriculture have been subject to severe infections by diseases and insects. Common diseases and insects are white fly, aphids, mites, mildews and blight, but viruses have been reported to be the most serious and difficult. Insects and mites are controlled chemically. The soils of the country are generally infested with nematodes and soil pathogens. Soil solarization is applied successfully to short-season vegetables. Control measures against these pests comprise application of chemicals, including Basamide, Vydate and methyl bromide fumigation, as well as the use of resistant cultivars. Biological pest control is not practised and, because of the frequent chemical treatments, natural enemies are almost absent in greenhouses although they may be found on field crops.

Weeds do not cause a serious problem in protected vegetable production. Annual weeds are the most common and their control is almost exclusively cultural; no herbicides have been used other than on a trial basis. Weeds outside the greenhouse may be important secondary hosts for pests and viral diseases, but are generally ignored as such.

In general, considerable research has been done on the selection of suitable crops and cultivars, drip irrigation, ground-mulching, dates of planting, shading, plant density, fertigation, pruning and cropping patterns. Many of the positive results are being transferred to farmers' fields through an organized demonstration program.

In summary, various degrees of success have been achieved in this field. Further progress, expansion and development of protected vegetable production are generally facing the following constraints:

High initial cost of agricultural inputs
Lack of skilled technical personnel
Lack of an efficient and economic cooling system
Pests and diseases in soil and on plants
Marketing of the produce
Need for diversification of crops.

Technology to be Developed

Improvements in structural design of the tunnels with more emphasis in multi-span tunnels for better utilization of limited land resources.
Improved cooling system for out-of-season production.
Introduction of soilless culture techniques and systems.
Development of integrated pest management and biological control.
Better utilization of limited land and water resources.
Introduction of new crops and cultivars and cultural techniques adapted to protected agriculture and the arid desert environment prevailing in the country.