



Greenhouse Structures and Fertigation Systems for Crop Production in Tropics

By: *Engr. Dr Rezuwan bin Kamaruddin, Grad. IEM*

CROP PRODUCTION CONSTRAINTS

Conventional high value crop production in an open field is susceptible to extreme solar radiation, high rainfall, weed competition, pests and diseases. Pest and disease damages were reported to be between 50%-100% if the infestation is high. The spraying of weedicides, pesticides and fungicides is necessary to ensure the continuation of crop production. However, excessive chemical spraying often leaves a high amount of residual in the produce which is harmful for human consumption.

A continuously high level of rainfall damages young plants, flowers and fruit settings. The cultivation area becomes wet and is exposed to the spread of diseases which impedes mechanised crop maintenance. Moreover, the surface runoff will wash away valuable fertiliser.

Extreme long wave and short wave solar radiation are detrimental to crop growth in the tropical region, however, photostically active solar radiation (PAR) is required for the photosynthesis process. During the drought season, an irrigation system is necessary. Therefore, greenhouses structures and fertigation systems were developed to address these constraints.

GREENHOUSE STRUCTURES

Several greenhouse structures were specifically developed for the Malaysian environment. These structures are naturally ventilated and mechanically controlled environment greenhouse structures. Standard engineering codes of practice, and plant physiological and agronomic requirements are considered in the design of these structures. The naturally ventilated greenhouse structures are rain shelter, insect-screen, insect-screen rain shelter and solar radiation shade.



Naturally ventilated insect-screen rain shelter structure



Naturally ventilated insect-screen greenhouse structure



Cauliflower production under mechanical controlled environment greenhouse



Tomato production using fertigation system



Melon production under naturally ventilated insect-screen rain shelter greenhouse structure



Cabbage production under naturally ventilated insect-screen rain shelter greenhouse structure

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The basic materials used to construct naturally ventilated greenhouse structures are concrete foundation, galvanised steel structural frame, transparent polyethylene thermic film, polyethylene insect-screen, polyethylene shade net and cladding clamp profile. The enclosed crop growth chamber or naturally ventilated greenhouses assisted by mechanical environmental control means are typical examples of mechanically controlled environment greenhouses. Examples of mechanical means are artificial lighting, carbon dioxide injector, cooling systems, ventilation or fertigation systems.

IRRIGATION AND FERTIGATION SYSTEMS

Various types of irrigation systems were also developed for crop production under greenhouse structures. Basically, the systems are micro drip, sprinkler and hydroponics. Micro drip and hydroponics systems supply water with

a fertiliser solution directly to the crop root zone. These systems are frequently called fertigation system. The micro sprinkler system supplies water or foliar fertiliser to the crop canopy and also the root zone.

The hydroponics systems are made static or with a recycled nutrient solution. Examples of the hydroponics systems are ebb-flood, aeroponics, deep flow technique, nutrient flow technique and static aerated. The basic components of all systems are the water source, nutrient tank, irrigation controller, water pump, distribution pipe, pressure valve, gate valve, nozzles and growth media.

THE COMMERCIAL POTENTIAL OF HIGH VALUE CROP PRODUCTION

Varieties of high value tropical, sub-tropical and temperate crop have been successfully grown under greenhouses in the lowlands as well as the highlands.

For example, the Chinese cabbage, kailan and star fruit grow well under naturally ventilated insect-screen greenhouse structure using the micro-sprinkler irrigation system. Broccoli, cauliflower, cabbage, tomato and melon have also adapted well using the fertigation system under naturally ventilated and mechanically controlled environment greenhouse in the lowlands.

However, herbs, ornamental plants and flowers are more suited to the solar radiation shade greenhouse structure using the micro sprinkler and fertigation systems. Most of the crop production under the greenhouse structures and fertigation systems produce a high yield and premium quality produce compared to the open field production. In addition, crop production is also continuous throughout the year, technically feasible and economically viable. The fruits and vegetables can be grown organically and chemical free. ■