Crop management

Greenhouse production in Malaysia

Horticulture production in Malaysia is located mainly in the highlands. Further expansion in this area is not possible. Growers are having to move to the lowlands, but the particularly high temperatures and humidity make this area less favourable for greenhouse cultivation. A recent study by Wageningen UR Greenhouse Horticulture in the Netherlands, however, demonstrated that greenhouse production is certainly possible in this area, if good use is made of technical possibilities.

By Uiko Reinders

Malaysia has some good opportunities for horticultural production. A major plus point is the large home market, with 26 million inhabitants and a steadily growing national income that reached US$ 13,800 per person last year. And the market is even larger than this, as the prosperous city-state Singapore is nearby, with 5.6 million mouths to feed. At the moment, Malaysia's economy is struggling, due to the worldwide economic crisis. This is partly due to its strong dependency on the export of natural oil, gas and palm oil. For the long term, however, the prospects are good.

The main production area for temperate vegetable crops in Malaysia is the Cameron Highlands and the main products are tomatoes, cucumbers and chillies. Land for extension in this area, however, is scarce. Horticulture must compete with the tropical rainforest, which the government wants to protect. The reason why growers prefer to produce in the highlands is the cool climate. The alternative is the coastal plains, where sufficient land is available, but these areas are regarded as too hot and humid for crops as tomatoes. It is precisely in these areas, however, that the government wants further expansion of horticultural production to take place. Moreover, the authorities have also decided that horticulture is to be one of the target industries for the future, both for the local and export market.

Aware of the climate in the lowlands, the Dutch Ministry of Agriculture, Nature and Food Quality invited Wageningen UR Greenhouse Horticulture, part of Wageningen University and Research Centre (WUR), to study the possibilities for horticulture. Anne Elings, Jouke Campen and Silke Hemmings visited a number of farms in both the Malaysian highlands and lowlands to investigate the situation.

All aspects must be optimised

Back in Wageningen, the researchers worked on their observations. They concluded that temperate climate vegetables and flowers can be produced in the Malaysian lowlands, but that it is at the limit of what is possible. In other words: for an acceptable production and quality, all aspects of greenhouse construction and crop management must be correctly implemented. What this means, however, was apparently not always obvious to the growers. During his trip, Elings observed that, although growers were trying hard to get the best results, they fell short in several aspects of production. Insufficient greenhouse ventilation is one aspect, which results in very high temperatures under the plastic. In addition, to save on fertiliser costs, growers had decided to fertilise only a few times per day with small quantities. "The quantities were so little that pots dried up in between two applications of water, which negatively affects plant growth." Elings also noticed that pruning of pepper was not a common practice. "As a result, crops get bushy and dense and cannot be entered for spraying, harvest or inspection." In addition, although growers use nets in side walls to protect their crops from insects, in some cases the nets were raised for cooling, meaning that insects could enter the greenhouse.

Improve knowledge

According to Elings, the more fundamental source of crop husbandry problems in Malaysia is a lack of current knowledge. It looks as though growers are not really aware of the background behind cultivation measures," explained Elings. This is needs to be addressed by required developments in education and research to support innovation in the sector.

Elings believes that good knowledge will be particularly important when growers start to produce under the difficult conditions in the lowlands. "Production in a greenhouse is complicated since it is a complex production system in which the grower has to make many decisions," commented Elings. As a short-term solution, the WUR team advises to start training farm managers and farm workers. There are plans to implement this at the demonstration greenhouse that is planned at Serdang near Kuala Lumpur. For the long term, the team advises the creation of a network of advisors and the strengthening of horticultural education and research.

For success, Elings also stressed the importance of optimising all parts of the production (see the practical guidelines below from the WUR researchers). "A crop will not benefit from a proper irrigation and fertigation system, if at the same time the ventilation of the greenhouse is not good. All aspects must be optimised."

Practical guidelines

Always keep enough water in the root zone

Because of high transpiration in a tropical environment, it is important that water is always available in the root zone of plants.
ian lowlands needs special care

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Greenhouses in the Cameron Highlands where most of the tomatoes, cucumbers and chillies in Malaysia are produced. Further expansion of the production should take place in the coastal plains, where sufficient land is available. Because of the high temperature and humidity in this area, special measures must be taken for a good production.

to meet their demand for water. If not, stomata close and CO₂ exchange gets reduced, affecting growth and production. The best approach is to apply water in small quantities with a high frequency. The frequency must be increased when radiation is greater. It is also important to apply the correct amount of nutrients; both too much and too little will have a negative effect on a crop. To avoid nutrient build-up in the substrate, extra water must be applied to flush away the excess nutrients. This approach is different from some current practises in Malaysia, where water is applied approximately five times per day, leading to extended periods with insufficient water for the roots. At noon, this even leads to hanging leaves. By sparse watering, growers try to prevent the water from draining away in order to save costs on fertilisers, which have become expensive. The solution for this can be a water re-circulation system with a treatment unit and filter to prevent the spread of disease and to maintain the correct nutrient content.

With good pressure-regulated drippers, the water can be distributed equally over all the plants, resulting in an even growth of the crop.

Avoid bushy growth
It is important to avoid bushy and dense growth in sweet pepper crops because it leads to small fruit, low ventilation and the inability to enter the crop, which results in higher labour costs. The WUR advice is to limit the number of shoots per plant. Experiments should determine the optimal number of shoots. With a more open crop, workers can monitor the crop more easily and take better decisions, for example, regarding pest control. It also leads to a less humid climate with more air movement, which is good for the crop as well as the workers.

Use special bags
The use of special polybags is advised, which are black on the inside and white on the outside, making them impervious to light. It is not advisable to use transparent bags, because they allow radiation to penetrate, causing algae growth and a higher root temperature. Larger bags are safer because they allow a better water buffer.

Introduce a scouting system and biological control
The observed pest and disease control can be improved by spraying at the location the insects are found. A scouting system is the basis for such a strategy. It is also important to precisely determine the amount of active ingredients and to close greenhouses with nets. Important for Malaysian production is the training of scouts and the availability of good pesticides. In the longer term, the introduction of biological pest control should be considered. This requires raising awareness in the farming community, and discussions with government bodies on rules and legislation to enable the import of beneficial insects. Moreover, as a rule, in a maturing market, the interest in chemical-free products will rise. Another option might be the
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<th>With insect net (+1°C), no wind</th>
<th>With insect net and wind (−50%)</th>
<th>Max. inside</th>
<th>Max. outside</th>
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<th>Average outside</th>
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The greenhouse, with a span width of 6.4 metres, has a chimney on top. This chimney is open on two sides, where the wind blows through, creating a suction effect. In addition, at a height of 1 metre from the ground, the greenhouse is open with nets at the sides, so that air can come in. Inside the greenhouse, the air moves upwards, through the transpiration of the crop and the chimney's suction effect, to the top of the greenhouse. The rising air leaves through the vents. This system works even without wind because upward movement of hot air in the greenhouse always takes place. However, it works much better with wind because the wind blows through the openings in the ridge and sucks the air in the greenhouse upwards.

The length of a greenhouse has no influence on the difference between the inside and outside temperatures, but when more spans are placed next to each other, the cooling capacity of the greenhouse is decreased - therefore increasing the temperature difference between the inside and outside. The reason for this is that the inlet of air is distributed over a larger space. This can be seen in Table 1, where in a greenhouse with one span, no insect nets and no wind, the temperature inside is 1.45°C higher than it is outside, whereas this difference is 6.25°C in a greenhouse with 10 spans next to each other. The Table also shows the calculated situation with insect nets in side walls, which hinder ventilation and therefore make the greenhouse 1°C warmer. In the third situation there is wind, which decreases the warming up by approximately 50%. The WUR calculations on inside temperatures are based on the temperatures in Kuala Lumpur: the average day temperature is 27.5°C and the average maximum temperature per day is 31°C. Scientific research is scarce on optimal and maximum temperatures for greenhouse crops in the tropics. The WUR team assumed, based on discussions with growers, that crops would be able to tolerate temperatures above 35°C for at most 1–2 hours per day.

To be on the safe side (i.e. with greenhouse temperatures maintained below 35°C), in a situation without wind and with insect nets, the maximum number of spans for the Kuala Lumpur area is 4. With this construction, the average maximum greenhouse temperature would be 32.9°C, and 35°C would be exceeded for at most 1–2 hours per day. If a grower decides to build a greenhouse of 10 spans next to each other, he must take into account that the average maximum greenhouse temperature is 34.7°C, and that 35°C is exceeded 60% of the time.

Elings stressed that these figures are based on theoretical estimations, which should be repeated for any other area. There are also other factors that determine the maximum temperature of a crop. One such factor is the relative air humidity, which affects the transpiration rate and cooling capacity of the air. Another factor is that a fully grown crop with a large canopy has a better cooling capacity than a young crop.