HORTICULTURE

Grower Summary

PO 018

Review of hydroponic flower production techniques and future opportunities for the UK industry

Final 2014

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GROWER SUMMARY

Headline

- Coir, perlite and rockwool substrates represent lower risk, transitional production systems, when moving towards protected cut flower hydroponics direct from soil culture.
- More advanced nutrient film technique (NFT) and deep water culture (DWC) could be used once growers are fully attuned to the control needed for such systems.
- However, an investment in accurate nutrient dosing equipment and also computerised pH and EC monitoring is essential for success, regardless of the chosen hydroponics system.
- The design of the hydroponic system should also allow for the future requirement to capture and recirculate all drain water created after irrigation of the crop.

Background

This report reviews information on hydroponics, the science of growing plants without soil, in relation to the production of cut flower crops. In addition, the suitability of currently available hydroponic systems for the intensive production of cut flower crops is also discussed.

Many crops grown intensively over a long season of production, for example UK tomatoes, cucumbers and sweet peppers, have been cultured in a range of hydroponic systems for over 40 years.

The main decision parameters involved in using hydroponics for these crops included the need for improved control over plant growth, leading to higher yields and better marketable quality. In addition, added control over attack by plant pathogens was a further driver towards the use of hydroponics.

The use of soilless cultivation on inorganic substrates is one of the most efficient alternatives to soil sterilisation, since it provides a pathogen-free root environment at planting.

The need to consider hydroponics in cut flowers has been highlighted by the appalling growing conditions of 2012, which led to a large amount of crop loss in certain sectors of the industry, due to disease. This was especially true of column stocks, with some growers losing up to 25% of their crop. A number of leading stock growers have therefore been instrumental in the development of this project.

Summary

In commercial horticultural crop production, the move away from soil in the 1970s to peat-based systems was stimulated by the need to control problems with soil pests, diseases and nutritional imbalances.

In peat systems, practical problems with water content, water availability and nutrient balance limited its application to certain crops, such as tomatoes. All peat systems require a constant supply of nutrients, either in the form of a slow-release fertiliser or as liquid feeds. Depending on the composition and chemical stability of the background water, nutrient imbalances may quickly occur.

Practical experiences on Jersey with the use of peat bags for the production of spray carnations and pinks highlighted problems with variable moisture availability and also susceptibility of the plants to diseases, such as *Fusarium* species.

Research completed at the States of Jersey Department of Agriculture and Fisheries, Howard Davis Farm glasshouse unit, identified several useful alternative substrates, such as pumice, clinoptilolite zeolite, nutrient-loaded clinoptilolite zeolite, perlite, polyurethane foam and products made from forestry residues.

Most of the active research on hydroponic systems took place over the period 1989 until 1998.

The introduction of rockwool (stonewool), as a plant growth substrate in the early 1970s, revolutionised the crop production industry worldwide. Rockwool has been successfully used for long-season production of roses for cut flowers, both in Holland and Guernsey.

Coir is a useful peat replacement material and its popularity as a substrate in UK glasshouse crop production is now increasing.

Using column stocks as an example, control of *Fusarium* species in the soil has become increasingly difficult over the last ten years, resulting in reduced yields and variable flower quality (Figure 1). In the absence of suitable chemical controls, the reliance on sheet steaming has increased in recent years. However, due to high energy and labour costs, coupled with variable results and negative impacts on soil structural and biological parameters, growers would now like to move away from steaming and towards the use of hydroponics.

Therefore, following continued problems with disease control in soil-grown crops, there is renewed interest in hydroponics and this has resulted in small-scale trials using coir and also a modified form of nutrient film technique (NFT) known as deep water culture (DWC), or

deep flow technique (DFT). Coir is one example of **substrate hydroponics**. In contrast, NFT and DWC are two examples of **solution hydroponics**.

Deep or direct water culture is a hydroponic method of plant production by means of suspending the plant roots in a solution of nutrient-rich, oxygenated water. Trials on DWC have involved containers, with plants suspended above the water reservoir on a sheet of polystyrene, for example.

Figure 1. *Fusarium* species in soil grown stocks

Hydroponic systems allow plant growth characteristics to be very carefully controlled. During the crop establishment period, for example, the moisture content of substrate systems may be decreased to encourage root development. As most substrate hydroponic systems require a constant supply of nutrients, the liquid feeding regime may be varied, to encourage vegetative growth., The fertigation strategy may then be further adjusted, in order to support the development of flowers and to ensure a consistent flower product and attendant vase life characteristics.

Investment in accurate nutrient dosing equipment is essential to ensure that the irrigation and liquid feeding regime is carefully controlled. In addition, accurate measurement and adjustment of both pH and EC of the applied feed is essential to ensure success in hydroponics.

In terms of solution hydroponics, general interest in NFT decreased for a number of reasons, including the high initial capital cost, system failures, nutritional problems and plant losses through root disease. Specific issues with acid overdosing, low oxygen concentrations in the

NFT solution and accumulation of unwanted ions (such as sodium, chloride and sulphate) increased the risk of crop loss.

These highlighted risks also exist for production of crops in any nutrient recirculation system, including all types of solution or substrate hydroponics.

Therefore, further research is required to reduce these risks to a minimum and ensure that reliable production may be maintained. In addition, growers face the situation where drainwater volumes must be reduced and safely managed in the future.

Tables 1 and 2 summarise the current position with regard to UK experience with each main substrate and solution hydroponic system. As may be clearly seen, there exists more information and knowledge of the management of substrate systems based on coir and rockwool. In terms of solution hydroponic systems, there is more UK growing experience with nutrient film technique and much less involvement with Deep Water Culture systems at present.

These tables also indicate where future research and development should be targeted, in order to provide growers with a more robust knowledge base going forward. For example, although there is interest in the use of Deep Water Culture systems for the production of UK cut flowers, there is limited European experience available at the moment.

In summary, it is proposed that the suitability of the following substrate systems should be determined for future UK hydroponic flower production systems: coir, forestry residues, pumice and rockwool (stonewool). In addition, the solution hydroponic systems offered by Botman Hydroponics B.V. and Cultivation Systems B.V. should be further explored for cut flower production and thoroughly tested under UK protected crop conditions.

Table 1. Summary of substrate hydroponic system characteristics

Substrate System	**UK System Experience**	**Overall Complexity**	**Skill Level Required**	**Cost of Installation**	**Re-use and Disposal**
Coir					
Woodfibre					
Pumice					
Perlite					
Rockwool					

Table 2. Summary of solution hydroponic system characteristics

Solution System	UK System Experience	Overall Complexity	Skill Level Required	Cost of Installation	Re-use and Disposal
NFT					
DWC / DFT					
Aeroponics					
Aquaponics					

Key

NFT: Nutrient Film Technique

DWC / DFT: Deep Water Culture / Deep Flow Technique

Suggested Trials for 2015

- The development of a robust substrate hydroponic production protocol for the culture of UK column stocks in coir and also solution hydroponics.
- This should include a comparison of stocks grown using coir in open containers, metal racks, gutters and also specific coir slabs.
- The suitability of existing crop support rack and growing gutter systems should be compared under UK growing conditions.
- Examination of practical solution hydroponic systems – such as Botman Hydroponics and 'Dry Hydroponics' – and their suitability for the production of UK cut flower crops, such as stocks and lisianthus.
- Comparison of other solid substrates for production of UK annual flower crops, including pumice, perlite and woodfibre products.
- The use of accurate dosing equipment and pH / EC monitoring should also form part of these trials.
- Production of reliable and specific nutrient target concentrations for input liquid feeds, rootzone and plant leaf tissue.
- Development of a strategy for recirculation of drain water from UK cut flower production systems, involving both solution hydroponics and substrate hydroponics.

Financial Benefits

Following investment in the appropriate hydroponic system and monitoring equipment, it is expected that a 10% minimum increase in yield of marketable cut flower stems will result.

In addition, improved control of pest and disease issues should be possible, further improving the overall marketability of the crop and reducing production costs.

It will also be possible to save the cost of energy and labour used for soil sterilisation.

Other savings will include water and fertiliser use and it is anticipated that a saving of up to 40% on water costs will be possible by precision irrigation and recirculation of nutrient solution or drain water.

Action Points

- Points to consider in choosing a suitable hydroponic system include, the degree of complexity required in the initial investment, the integration of the system with the existing crop production schedule and the cost of materials.

- Isolation of the hydroponic system or containerised substrate from the glasshouse soil will be essential to reduce the risk of disease contamination and spread.

- Initial considerations should include how to regulate, collect and manage drain water from the hydroponic system. If it is not possible to initially equip the installation for full nutrient recirculation, then future provision should be made for collection and storage of drain water.

- A thorough understanding of crop nutrition and the factors affecting nutrient availability in the hydroponic system needs to be acquired prior to installation.

- Once selected, the hydroponic system should be constructed and supplied with the appropriate accurate nutrient dosing control and monitoring equipment.

- The nutrient concentrations in background and stored water sources must be thoroughly checked by regular laboratory analysis and an appropriate nutrient recipe provided, to match the growth stage of the flower crop under cultivation.

- Nutrient targets are outlined in the science section of this report which will help steer plant growth and provide a nutritional base from which to refine the targets for specific flower types.

- Regular liquid feed, substrate, drainwater and leaf analysis must be employed to assist in crop growth decision management, to help achieve the optimum flower production and quality.