Soilless Cultivation

For Ornamentals

Contents

Tyfu Cymru: A Horticultural Manifesto for Wales

The Tyfu Cymru project's goal is to build the capacity and capability of the Welsh horticulture industry. Working with supply chain partners it will prepare growers and producer owned horticulture companies across Wales to adapt to future environmental challenges and position them to capitalise on market opportunities for business development and growth. This project will support the Welsh Government to realise its ambitious objectives for growth and rural regeneration through the innovative and sustainable development of the horticulture industry in Wales. Led by Lantra, working with key partners Puffin, Glyndwr University and ADAS, with funding from the Welsh Government Cooperation and Supply Chain Development scheme, it will provide a blend of strategic leadership, skills development, training and support tailored to the needs of the industry. It will draw on evidence gained from expert horizon scanning and analysis of business needs, and it will demonstrate the social, environmental and commercial benefits for businesses and the Welsh economy.

Is this your opportunity to develop your business? The grower toolkit highlights the benefits and practical tips for soilless growing and how using innovative methods with the right support can take your business forward.

What we offer:

- Funded innovative training and skills development
- A horticulture talent pool programme
- Supply chain and cluster support
- One stop knowledge hub offering an industry voice.

If you would like to find out more about any aspect of commercial growing and how to develop your horticulture business please contact Tyfu Cymru via email at **Tyfucymru@lantra.co.uk** or see what we're doing by keeping up with Tyfu Cymru on social media: find us on Facebook at **tyfucymrugrowingwales**, or on Twitter **@TyfuCymru.**

About This Grower Guide

Growing crops without using soil is widely practiced in horticulture as an efficient and cost effective method for the production of high throughput, high value edible crops. Control and the proportion of marketable yield can be further enhanced by using soilless systems under plastic or glass growing structures. Covering the crop not only "keeps the weather off" but with appropriate site logistics can integrate the use of lighting and heat to extend the growing season, and with sufficient investment realise all year round growing. The Agricultural Land Classification (ALC)[1] of Wales defines the top three grades (1-3a) as the 'Best and Most Versatile' agricultural land, and accounts for 7% of the total land in Wales. Soilless cultivation also removes any limits on cultivation imposed by soil type or the availability of space, offering a chance for growers to use a new way of growing to increase and diversify their outputs. As such, soilless cultivation has been identified as a key innovation that could be exploited to promote development of the horticulture sector in Wales. The methods used for soilless cultivation are numerous and can be tailored to suit new or existing holdings. This document has been prepared to provide summary information around soilless cultivation to help promote the uptake of new growing methods in the Welsh horticulture sector. How to establish soilless cultivation is outlined, along with advice on integration into existing production and marketing routes so that growers can implement selected techniques as part of their enterprise.

[1] http://lle.gov.wales/catalogue/item/PredictiveAgriculturalLandClassificationALCMap?lang=en

1 Introduction to Soilless Cultivation

Growing plants without soil is a precise method to deliver water and nutrients to match crop demand; because of the enhanced availability of resource to the root-zone, crops can be grown at a higher density than would be possible in the field. Ornamental crop production requires robust plants that can be grown to a tight schedule and specification which are sufficiently tough to show vigour before and after sale. The ornamentals sector is also seeking to optimise resource use efficiency, particularly in terms of substrate use, to enhance both its environmental and economic sustainability. Hydroponic growing techniques can be used to achieve these aims in a variety of ways.

Rather than relying on soil to provide water and nutrients (supplemented with fertilisation/irrigation as required), hydroponics use an inert substance to provide structure and support for the roots, while carefully controlled nutrient solution applications provide all the water and nutrients that the plants need throughout their lifecycle. This can be used on a wide variety of scales from a shrub in a 2L pot to a six-pack of varied bedding plants, but in each case a plant is grown with a well-developed, compact root structure in minimal amounts of substrate. The technology can also be applied in the cut-flowers sector, where longer grown plants such as rose can be maintained in a productive state throughout the season.

Hydroponic production can be extended to a wide range of plant types grown in the same system. For Welsh growers focusing on local supply, the ability to provide a range of plant types to their customers will increase customer access. Precision application can shorten cropping times, enhancing the ability of growers to match customer orders and periods of peak demand. The systems can also be extended to cover edible crops (especially herbs) which growers can use to further expand their product range. Through this route, hydroponic product aligns with the long-term vision of the Welsh Government for horticulture, both by promotion diversification away from traditional horticultural outputs and by enhancing the efficiency of production from raw resource inputs to short, more compact local supply chains.

High planting densities also increase the efficacy of biological controls for pests and diseases, and better control of the root-zone allows for reductions in persistent root diseases. Low labour costs result from stacked or table-height production, and the ability to control the growing environment means that optimum resource efficiency can be achieved while offering a highly uniform and consistent product that has the potential to be grown year-round. Cultivation without soil also means that the crop won't become contaminated with soil enhancing marketability. The recirculation of water and nutrients means that water wastage is 20 times less than that typically seen in soil grown systems, enhancing the sustainability of the cultivation process. While soilless cultivation methods can be started on the small scale using simple technologies, it also blends well with innovative growing technology such as light-emitting diode (LED) lighting, crop sensing technology and carbon dioxide enrichment; providing excellent scope for expansion and growth.

This document has been written as a practical guide for growers who are seeking to diversify their business using hydroponic techniques.

2 Hydroponic Growing

Growing plants without soil is an efficient way to provide water and nutrients to a crop, and allows them to be grown at a higher density than would be possible in the field. It also allows tight control of the growing conditions so that optimum quality produce can be grown, and as a balanced, homogenous substrate mix can be used - greater uniformity can be achieved throughout (**Fig. 1**). Control can further be enhanced by using substrate mixes which include elements to balance water and nutrient retention to achieve optimum water and nutrient access to improve rates of growth. Hydroponic systems' ability to mitigate against the build-up of soil-borne diseases allows for continuous production, without the need for rotations or chemical controls. Management of applied water and nutrient affords the grower control over pH, electrical conductivity (EC) and soil moisture, and therefore also greater efficiencies in scheduling of plant production and flower development the ability to match pre-defined or shifting marketing schedules.

A core feature of any hydroponics system is the use of a carefully controlled nutrients; either mixed directly with the substrate, or applied in the form of a nutrient solution. For ornamental production, water and nutrients are applied in a controlled fashion to a relatively inert substrate. This can be applied in a non-recirculating manner - where it is not recaptured, or in circulating systems - where runoff solution is maintained as a recirculating stock which is collected after application to the crop, ensuring high efficiency of resource use and minimising the environmental impact of nutrient run-off. This is compatible with both liquid and controlled release feeds depending on grower choice. Two key features of the nutrient solution that will require control are pH and electrical conductivity (see key terms below).

Fig. 1: Zonal Pelargonium in capillary matting irrigation system.

Key Terms – Ornamental Production
pH – This is a measure of the acidity (below pH 7) or alkalinity (above pH 7) of the solution. This can have an impact on the availability of certain nutrients if the pH is too far from optimum, although this can be highly crop specific.
EC – Electrical conductivity (EC) is a measure of the proportion of ions dissolved in the solution. Nutrients dissociate into positive (e.g. K^+, NH_4^+) or negative (NO3-, PO_4^-) ions. As these conduct electricity, solutions with more nutrients dissolved give a higher EC (normally measured at µS cm-1 (microSiemens per cm). High EC can lead to plant damaged through toxic nutrient concentrations or difficulties absorbing water, or low EC can lead to stunting and other nutrient deficiency symptoms. EC changes with base water input, and should be regularly monitored.
Controlled Release Fertiliser – An alternative to liquid feed. Loose granules are worked into the substrate before use that slowly releases nutrients over 3 to 18 months.
Plant Growth Regulator – Chemical mimics of natural growth regulators which can be applied to control canopy growth and shape to improve canopy compaction and enhancing flowering in ornamental crops such as cycocel and Bonsai®.

Nutrition

The majority of ornamentals produced in the UK are grown with Controlled Release Fertilisers (CRF's); and depending on the CRF's used may provide nutrients gradually over a short period, or up to 18 months or greater for longer term crops. The popularity of CRF's in the ornamentals sector results in part from the complexity of matching fertigation requirements of small lots of many different plants, but also since they also reduce the number of applications and hence labour requirements, and also improve the efficiency of nutrients supplied, including in many cases the required trace elements.

As the name suggests, nutrients are supplied to the growing plants in a controlled manner, as the factors affecting the rate, pattern and duration of release are carefully evaluated. Controlled release is achieved by enclosing deposits of soluble nutrients within one or more layers of polymer which allows water to penetrate, and then the gradual diffusion of dissolved nutrients through the polymer coating into the growing media. This continues until all the nutrients are released and the coating naturally decays, leaving no residues in the substrate.

Nutrient release is temperature dependent and so is generally in line with plant demand. As a result, it must be noted that higher temperatures under protection and the type and rate of CRF used must take this into account. The longevity of the CRF decreases with increased temperatures, as the concentration of nutrients released increases. Under these circumstances, nutritional programmes based on CRF's must use lower fertiliser rates; whereas for newly potted material, when lower temperatures prevail, supplementing them with base fertilisers allows for more immediate nutrition. In situations where temperatures are adequate for sufficient nutrient release to the medium, growers must be aware that release of initial diffused nutrients may take roughly 7-10 days. Liquid feeding may also be used to provide additional nutrition, particularly when the CRF in the medium is exhausted, possibly due to unseasonably hot weather or to match shifting marketing dates.

CRF's can be classified by their nutrient ratios, release pattern and longevity; the choice of which to use and the rate of application, or which mixture of methods to implement will depend on the species grown, growth stage, irrigation system, container size and growing situation. Where a large number of species are grown, these are normally grouped according to container size and plant vigour, and therefore also nutritional requirements. CRF's range from mini granules applied at a rate of 0.5 – 1.5 kg/cu m, typically used for propagation of material in cells less than 5 cm, to long-term CRF's applied at a rate of 4.0 – 8.0 kg/cu m for vigorous species and trees. It is advised that you consult the documentation of the CRF suppliers (some of which are listed in section 6 of this toolkit), or seek advice from an independent FACTS qualified advisor to match the correct CRF products to plants grown.

The even distribution of CRF's within the substrate encourages uniformity across the whole crop, however mixing must be done with due care to ensure the coating is not damaged, as this can cause oversupply of fertiliser salts, causing symptoms of toxicity to established plants, or death of seedlings or cuttings. Monitoring of the substrate EC using a conductivity meter or measuring the leachate from a cluster of containers is advised every month, and particularly over periods of warmer weather.

Hydroponic Techniques

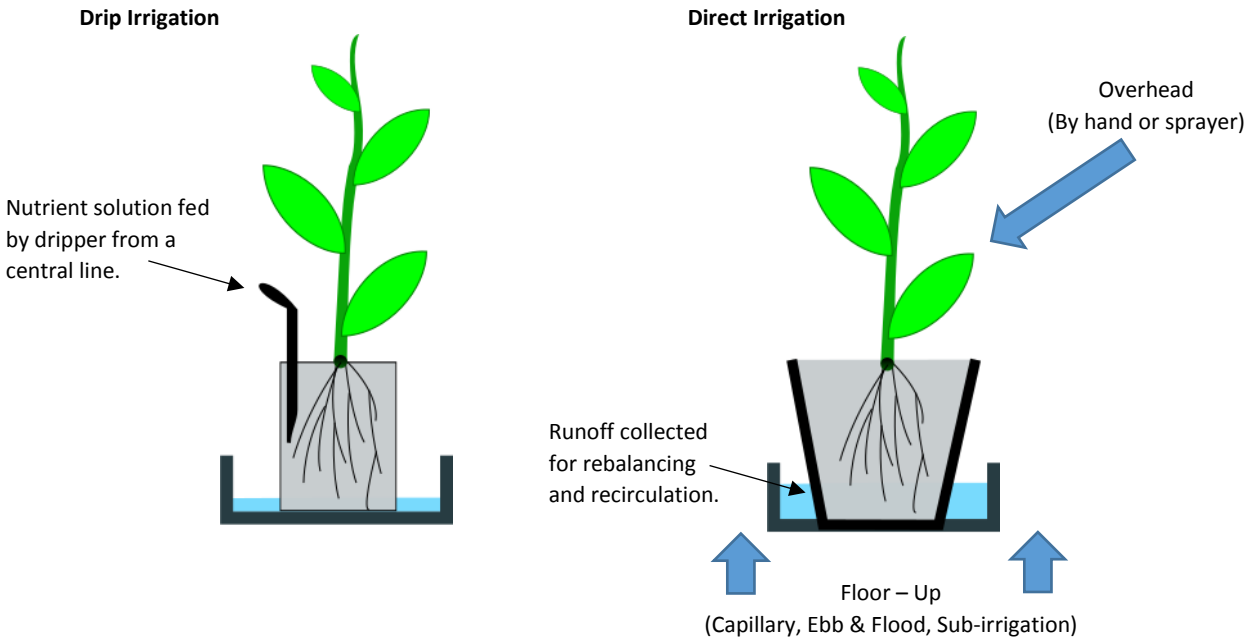

Fig. 2: Substrate systems, highlighting slow surface applied nutrient solution (drip irrigation) and rapid sub-irrigation (Ebb and Flood)

A key feature of any hydroponic system is the nature of the nutrient solution application, and this is heavily based on product type and available infrastructure. In both instances, juvenile plants in plugs will be transferred to a substrate mix, either a plastic six-pack or into 2L or 3L pots. These will then be typically placed under protection (glass or polytunnel) for growth and maturation. Nutrient solution applications give much greater control of nutrient availability than controlled release fertilisers, giving the grower the opportunity to ensure optimum dosage across the season.

Drip Irrigation

Large plants (trees, specimen plants and larger bushes grown for cut flowers) are best fed by drip irrigation (**Fig. 2**). Drippers are inserted into the substrate of each pot supplying the plants with water. CRF's eliminate the need for stock solution tanks and accurate dosing equipment; as only water is fed through the irrigation system.

Where a nutrient solution is used, it is relatively simple to implement as only a single mixing and pump system is required. Nutrient solution is typically applied so that a small amount of runoff is achieved to ensure adequate dosage, and this is typically no recaptured. Greater volume of substrate will also provide stronger buffering of nutrients, but can lead to a high EC through salt accumulation as this is not washed out over the growing cycle. This system is also best suited for plants that can be sold as a block rather than one-at-a-time as it can be difficult to isolate individual drippers when single plants in the system are removed. Irrigation rates and substrate choice must be made to suit drip irrigation to ensure adequate watering of the root-zone.

Direct Irrigation

An alternative to this can be seen in direct irrigation, which comes in a variety of forms. This is particularly suited to smaller plants grown in 0.5/1L pots or in trays. Juvenile plants in plugs are placed into the substrates (typically using robotic transplanters) into trays or pots than have been prepared by tray or pot filling machines. A small amount of fertiliser may be included in the substrate, but smaller substrate volumes means this may only last up to three months, requiring liquid feed application. Once potted up, the plants are transferred to a growing floor, or placed on benches at waist height under protection.

Direct irrigation (**Fig. 2**) can be most simply achieved by watering either by hand or by roof-mounted nozzle system linked to a computer control which provides a water spray, mist or fog to the crop. This can provide low labour irrigation, but water wastage can be high and droplets on the leaves can lead to disease problems relating from high humidity. Nutrient application can be achieved by including a master mix tank fitted with a Dosatron (**Fig. 3**; or similar constant flow injector) into the water line. This is not often recaptured, but as the bedding is typically grown in a dry root zone (to reduce risks of diseases like Pythium) and to keep a compact plant, this helps to ensure runoff is kept to a minimum. Correct crop density and substrate choice can be essential to insure crop water and nutrient demands are met.

Fig. 3: Bedding plants being grown under overhead direct irrigation. Nutrient solution in a master tank is injected into the irrigation supply which is applied by nozzles in the glasshouse roof.

Some plants, such as Poinsettia and Cyclamen do not grow well under overhead irrigation and soft parts like flowers can be easily spoiled, and these benefit from “floor – up” irrigation. This can be achieved by using capillary mating – a porous material laid on plastic onto which the pots are placed. Irrigation is applied between rows, allowing water and nutrients to soak up into the substrate through capillary action. A second layer of plastic is often placed on top of the capillary matting to limit evaporation and algae growth, enhancing the efficiency further.

The most advanced “floor – up” irrigation method is ebb and flood (**Fig. 4**). In this instance, plants are placed on shallow troughs which are periodically flooded with nutrient solution which drains away after a period of time for storage and recirculation. The nutrient solution can be drained off under gravity or actively pumped away, but these systems must be placed on a level surface to ensure good coverage of the nutrient solution. This system can be applied to a wide range of crops, but can be expensive to install and therefore is most effective when economies of scale favour larger production areas. This system can also be used at table-top height, making it easier to work with the crop, or it can be applied as a growing-floor. As the substrate is regularly flooded, nutrient content of the substrate is rebalanced

with each irrigation cycle, avoiding accumulation of salts in long-lived plants. Care must be taken to limit algae growth in ebb and flood systems, either by blocking light from reaching the flooded surface or by good sanitation measures.

Fig. 4: Ferns being grown on an ebb-and-flood growing floor. Nutrient solution is pumped in from below, flooding the growing floor for a controlled period of time before being drained for recapture and reuse.

Substrate Choice

All of these systems will require the use of a substrate to support plant growth and in the case of potted plants, provide part of the product supplied to the customer. Traditionally peat has been used, however, its use as a growing medium is now in decline due to concerns over its sustainability, meaning that many growers are seeking to reduce or replace its overall share in blended mixes. Many commercial growers are now regularly using media mixes with a minimum of 10% peat substitution, with the industry standard being a 25% reduction; and in many cases peat reduced options substituting up to 50%. A current five year cross-sector project led by ADAS is exploring how growers can formulate 100% peat free mixes without any appreciable reduction in quality or yield of the final product (**Fig. 5**); leading the way to prevent an overreliance on any one substrate[2].

Fig. 5: *Hebe* 'Heartbreaker' grown in peat-based (left) and peat-free prototype blend (right). Similar growth can be achieved by careful balancing of peat-free substrate materials, which promotes sustainable containerised production.

[2] Transition to responsibly-sourced growing media use within UK Horticulture. AHDB project CP138.

Numerous past studies have shown the benefits and shortcomings of single source mediums and blends on different crop groups and growing systems, and benchmarked against the industry standard, peat. In many instances coir, woodfibre, and bark have been shown to be the most useful bulking agents in blends, with green compost added sparingly as a useful buffer for added nutrients. In all instances adaptations have been made to irrigation and management practices to take into account the differing physio-chemical characteristics of the blends.

Coir is typically used as a substitute for peat, and it is often used as the primary constituent of a growing medium; often paired with substrates like woodchips. The relatively inert and slight acidic nature of coir makes it ideal for hydroponic use as it does not affect the applied nutrient solution. Coir fibre has good porosity allowing good gaseous exchange in the root zone. Its ability to absorb and retain large quantities of nutrients between irrigations means that less frequent irrigation events are required, and therefore less nutrient solution is lost through the crops' drainage allowance. As with irrigation water it is important for growers to sample their growing media prior to planting out. This should be done randomly; ensuring substrate structure, pH and nutrient levels are all satisfactory.

Plant behaviour in the supply chain must also be considered, as nutrient and water retention must be sufficient to give a good shelf life and to give good post-planting growth to ensure customer satisfaction. Substrate mixes can be used to buffer periods of poor irrigation/fertilisation during sale and establishment, although inclusion of controlled release fertilisers can be used to enhance this.

Types of Substrate	
Peat	Peat has historically been the basis substrate for growing, but its use has been declining due to sustainability concerns. It offers excellent water and nutrient retention, although it is not inert and can carry a low pH. Although, peat is unsustainable and growers are seeking to replace it, peat-free mixes can be variable across different points in the season and using peat as a base avoids this problem.
Peat free (Blended raw materials)	Peat-free mixes can be variable across different points in the season and using peat as a base avoids this problem. Typically growers will use a blended substrate mix, including a variety of components to achieve optimum water and nutrient balance. This can be based on a blend of coir, green manure, woodfibre, bark and perlite. Such mixes can be purchased pre-blended to meet a range of crop requirements. The industry standard is now a 25% reduction in peat, often with bark or woodfibre, with reduced peat options substituting roughly half of the peat with aforementioned alternatives.
Peat Free (Coir only)	Produced from the waste husks of coconuts, coir is a common substrate for hydroponics. It offers better nutrient retention and buffer than rock wool and offers excellent aeration. It is relatively inert meaning that tight control of nutrients can be maintained, and is both sustainable and recyclable. This is available in prepared slabs of varying composition and typically blended with other components such as woodchips. Coir is best used for drip-fed irrigation, and is suitable for longer-grown crops such as roses grown for the cut-flower market.

Propagation

Ornamentals can typically be purchased as juvenile plugs from a commercial propagator. This means growers don't need to dedicate time, space and energy to propagation and can order uniform plugs to any desired production schedule. These will be compatible with automated planting machinery to further enhance labour use efficiency.

Crop Management

To achieve a highly quality, uniform product care must be taken to achieve optimum conditions. Substrate choice (**Fig. 6**) and cultivation practice can significantly impact the final product. Uniformity (both in size, canopy and flowering state) can be important for high value production of both pot-grown ornamentals and cut flowers.

Fig. 6: *Hebe* 'Midnight Sky' grown in five different substrate blends. Different canopy structures and densities can be achieved by careful management of crop growth, allowing products to be grown to tight customer specifications.

Care must be taken to avoid plant stress to ensure peak product quality. Stress, including root restriction, overcrowding or dryness can trigger flowering. Keeping the substrate dry can promote compact plants, or pre-stress plants to enhance survivability during drying out in the supply chain, or low-light conditions at the point of sale. Many specifications demand compact plants, and this can also be achieved through delivery of plant growth regulators (PGRs) through overhead sprays to limit canopy expansion.

Applying slight stress through high light and EC levels can further modify growth habit and enhance pigment foliage such as zonal Pelargoniums. Regular routine monitoring will be required to match control of the nutrient solution to the crop's need and environment, and it is best practice to monitor both master tank and runoff to gain an understanding of how the crop is interacting with the system. For example, under high light conditions water uptake is likely to outpace nutrient uptake, increasing EC in hot, bright conditions. More established crops will require longer, more frequent flow cycles in ebb and flood systems so that crop demand can be better matched with supply. EC, nutrient application and pH will depend on a number of factors including the crop grown, target growth stages for harvest, season, maturation and system used.

Optimum growth will be achieved where temperature and light levels can be closely monitored, and adjusted where the facilities exist. Production under glass offers more control than polytunnels, and this will help to ensure optimum quality is maintained and will extend the growing season. All-year-round production will be possible if supplementary lighting can be provided, and this can be of particular use in photoperiod crops or where seasonal flower is important (e.g. Poinsettias).

Pest and Disease Control

Regular monitoring of pest and disease incidence must be carried out to avoid yield loss. Control of aphids, whitefly and mites must be planned as part of a targeted IPM program. Good airflow is also essential to limit development of diseases such as *Botrytis*. Typical pest control measures (e.g. yellow

sticky traps for the monitoring and control of aphids and whitefly). Minimal water application and ensuring a free-draining substrate can also prevent moss/liverwort growth on longer-grown perennials (especially under protection) which customers will require.

Harvest and Sale

Plants picked for sale can be removed from the hydroponic system and transferred to Dutch trollies before supply to the customer. Taking harvested plants through a watering tunnel before dispatch can ensure the plants are well watered before entering the supply chain. Control of harvest should be carried out by following a production plan for each crop. For example, bedding plants show a three week period of growth and purchase of new plugs and timing of dispatch to customers must be aligned against this. Often adherence to a well-balanced production plan is essential to ensure a robust business by minimising waste while allowing growers to meet customer supply requirements.

3 Market Information

Currently the vast majority of ornamental plants sold in Wales are imported from either England or from abroad and there are great opportunities to strengthen local supply chains and to increase production of plant material which is well adapted to the location of eventual planting. The ornamental sector across the UK is currently worth more than £1 billion, with year on year growth seen in recent years. At present, up to 80% of plants sold in nurseries and garden centres are imported into the country, even though many can actually be grown here in the UK and this represents a really opportunity for UK growers, particularly in the event of “Brexit”.

Marketing Models

The focus of an ornamental grower can be tremendously varied in terms of scale, choice of lines and target customer. Large volume, bulk sales of low-value plants, particularly for landscaping which can be targeted into the wholesale or garden-centre market can be an option for larger growers. Profit can be achieved in this instance by maximising resource use efficiency, targeting narrow margins with an income derived from bulk sales. Typically these growers will offer a limited range of products to aid the streamlining of production, and these will be grown to tight production schedules to ensure good turnaround. Besides wholesalers, other large-purchase customers such as councils can follow this order scale. Price competition will also be a significant force here, especially with imports of plants like Poinsettia so growers must think careful about unique selling points and how to achieve maximum economies of scale. In these instances plants must be sold around £2-4 a plant, so production must be scaled to ensure this remains profitable.

An alternative to bulk sales of low value crops is to focus on small scale production of higher value products. These are typically more niche plants which are grown on a smaller scale which are marked to customers on the benefit of a unique quality. This may be novel plant lines such as exotics, orchids or specialist fruit/flower cultivars such as Welsh heritage top fruit lines. Growers must produce a wide range of lines, growing small amounts of each. High quality specialist plants may have greater labour inputs (particularly if propagating from cuttings on site), but higher value plants could be marketed for £10 – 15 per plant, particularly for larger grown trees and shrubs.

There is extensive scope for smaller growers to explore current marketing streams, such as plant fairs and events, farmers markets and market stalls, as well as direct sales through the internet, on site

nurseries sales and through mail order. It may also be possible for growers interested in the production of cut or potted flowers to explore the supply of florists and local stores and supermarkets, although in recent years much of the decline in the floral trade in cut flowers and potted plants has added to the gains of internet trade in both sectors; ideal for the specialised small scale grower.

Careful consideration of the plants, cultivars, costs and the competition must be properly evaluated before investments are made. Similar inefficiencies exist within different categories in the ornamentals sector as those already highlighted, with each crop group and marketing stream having its own advantages and disadvantages, and it is critical to properly evaluate your customer base to determine expected volumes, plants to be grown, and realistic profit expectations from the enterprise.

The cropping environment, irrigation system and nutrition strategy will ultimately be determined by these factors and the scale of the operation and the variety of plants grown should be congruent with the anticipated marketplace. Landscape architects for example priorities variety and quality over price, and will often seek out growers who can allow them to explore new designs. Depending on the scale of the designs, landscape architects may choose to purchase directly from wholesalers, due to their extensive range, or purchase directly from specialist growers who may specialise in a particular crop group or genus; particularly if they can be produced locally at competitive prices; ensuring hardiness to the local climate, ease of purchase and quality of planting material.

4 Business Development

Hydroponically grown ornamental lines may provide an excellent addition to a growers business. Before starting a hydroponics system careful consideration must be made of the market opportunities and how best these can be exploited.

Integrating Hydroponics into an Existing Business

A significant level of investment is required for an effective ornamentals business, and this can be minimised if a grower already has access to substrate processing machinery and automated potting-on equipment. Growing floors with direct application of nutrient solution represent some of the simplest ways of introducing hydroponic cultivation, even to the extent of being applied by hand. Many aspects of hydroponics are modular, so investment and development of both volume and technological capacity can take place as a market is established and growers develop their experience of this growing technique.

Biosecurity

To avoid pest and disease problems, care must be taken to fully inspect shipments of juvenile plant plugs, substrate and other growing materials to the nursery. This is particularly relevant if exotic plants are being grown, and all necessary legislation must be followed if imported material is to be grown on site.

Investment Potential

The benefits of hydroponic production make it suitable for external support, particularly via rural development program grants administered through the Welsh Government. The current program, running until 2020, is aimed at enhancing the competitiveness of Welsh agriculture, ensuring

sustainable resource management and efficiency of use, and promoting innovative farm technology. All of these themes are directly supported by hydroponic techniques, making grant support for the associated technology a realistic potential.

5 Ornamental Production – Case Studies

Since the 1970s ornamental plants changed from the supply of bare root balls between November to March to container production and all-year-round sales, especially between March to the end of June which is now typical across the industry.

One approach is to focus on high-value, niche products. One Welsh nursery focuses on growing high value, unique ornamental lines, many of which are new to their customers. The nursery is only 2 Ha, but employs four full time staff and up to six part time staff, all of which are highly skilled to produce high quality plant lines. The nursery grows upwards of 2000 lines, but only small numbers of each line are produced in a season to match customer demand.

Propagated plant liners grown in a 7-9 cm pot are transferred to a 2 or 3L pot containing either peat-free or peat-reduced substrate. These are then grown for 6 to 72 weeks under glass or plastic, with longer-grown plants typically achieving a higher market price. Plants are regularly checked for pests and diseases and where possible IPDM systems are used.

A peat free mix is bought in and is reliable and consistent, and the use of peat free does enable access to some better markets including the National Trust plant centres. The peat free mix has a controlled release fertiliser (CRF) added and these will provide nutrients over varying periods from 3 to 18 months and reduce the need for liquid feed.

These are specialist plants and are grown from seed, cuttings and field grown, the latter lifted and divided followed by hand potting with the high crop value not being impacted by slightly higher labour costs. The plants are then grown on in tunnels and outdoor beds with irrigation. There is very little mechanisation throughout the process because of small numbers and specialist nature of the crops but the niche nature of the plants allows them to be sold at a higher price so the lack of machines and rapid throughput are not important. For instance, a 3L potted shrub can achieve around £12 per plant.

The specialist nature of the nursery has caused them to develop strong direct-to-customer marketing routes. The nursery exhibits at horticultural shows including the RHS Chelsea Flower Show, and international shows on the continent. Direct customer sales are also achieved through an online shop. The website has to be kept up to date and this a large task as each entry requires a photo and a description on where the plant is likely to thrive but this improves customer communication and product exposure for niche lines which customers may be unused to growing. The market they use is constantly changing so the plant mix will vary from year to year, for example the original offer included a very wide range of hardy geraniums, but these have slipped out of fashion and now very few are grown and have been replaced by more on trend items. The ability to remain above trend allows them to market produce to customers seeking new lines that would not typically be found in main stream garden centres or suppliers.

As an alternative to the niche market, focus on bulk production of lower value crops can enable a profitable business to operate. A second Welsh nursery focuses on large scale plants are grown for the landscaping market and this is very competitive, but orders can be very large. Plants grown for landscaping can be sold for around £2.50 for a 3L plant, so margins must be carefully balanced to ensure good profitability (**Fig. 7**).

All of the plants are potted on mobile machines that are taken to outdoor standing growing areas and chemical weed control is a vital part of avoiding costs. Plant liners are bought in and self-propagated, where possible. To ensure sufficient volume of produce is available, the nursery focuses on 25 product lines, but over 100,000 plants of each may be grown in a season.

As the plants reach specification, they are packaged onto Dutch trollies to be sent out to the customer. The plants are picked off the beds as a complete clearance with under 10% waste factor and are stacked in large crates followed by road delivery to the sites, where they are planted by contractors. The nursery gets some leads on what is likely to be required and these are grown, with some R&D being done on potential new lines.

Fig. 7: Large scale production using overhead irrigation for landscaping customers.

6 Next Steps

The decision to develop a hydroponics venture must be based on a strong analysis of the potential market for ornamental plant products, both through existing market routes and the potential to access new customers. This will enable identification of likely product types and methods of production to be identified, which in turn will assist in the development of a financial feasibility study into the launching of a new hydroponics product line.

For growers inexperienced in ornamental plant production, discussion with independent advisors will be essential in identifying the best methods of exploiting hydroponic techniques, along with advice regarding crop management, agronomy and marketing to maximise the possible benefits of the new hydroponic venture. The unique nature of hydroponic growing will be its unique combination of potential challenges, and seeking advice will minimise the impact of these on new start-up ventures.

This section contains a list of suppliers, but shouldn't be considered as exhaustive, nor should they be considered as recommendations over other suppliers in the market.

SUPPLIERS OF SOLUBLE FERTILISERS

ICL
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Loftus
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Tel. (01287) 640 140
www.icl-uk.uk

Solufeed Ltd
Highground Orchards Office
Highground Lane
Barnham (Nr.Bognor Regis)
West Sussex
PO22 0BT
Tel. (01243) 554 090
uk.solufeed.com

Yara UK Ltd
Harvest House
Europarc
Grimsby
N E Lincolnshire
DN37 9TZ
Tel. (01472) 889 250
www.yara.co.uk

SUPPLIERS OF SUBSTRATES

Bord na Mona
Main Street,
Newbridge,
Co.Kildare
W12 XR59
Ireland
Tel. +353 45 439000
www.bordnamona.ie

Bulrush Horticulture Ltd
Newferry Road
Bellaghy
Magherafelt
County Londonderry
BT45 8ND
Tel. (0287) 938 6555
www.bulrush.co.uk

ICL
Boulby Mine
Loftus
Saltburn-by-the-Sea,
Cleveland
TS13 4UZ
Tel. (01287) 640 140
www.icl-uk.uk

Sinclair Pro
Bridges Road
Ellesmere Port
Cheshire
CH65 4LB
Tel. (0151) 356 6014
www.sinclairpro.com

EQUIPMENT SUPPLIERS

(F): FERTIGATION, (P): POLYTUNNELS, (C): CONSUMABLES

Bridge Greenhouses
Chalk Lane,
Keynor Lane,
Sidlesham, Chichester,
West Sussex,
PO20 7LL
Tel. (01243) 641 789
www.bridgegreenhouses.co.uk
(G)

Cambridge HOK
Wallingfen Park
236 Main Road
Newport, Brough
East Yorkshire
HU15 2RH
Tel. (01430) 449 440
www.cambridgehok.co.uk
(F), (G)

Elite Tunnels Ltd
The Office
Arnhall Farm
Edzell
Brechin
Scotland
DD9 7UZ
Tel. (01356) 648 598
www.elitetunnels.com
(P), (C)

Haygrove
Redbank
Ledbury
Herefordshire
HR8 2JL
Tel. (01531) 633 659
www.haygrove.com
(P)

HBS Design
Heron Buildings
Plaxton Bridge Road
Woodmansey, Beverley
East Yorkshire. HU17 0RT
Tel. (01482) 679 344
www.hbsdesigns.co.uk
(F), (G)

Hortech Solutions
Thingehill Court
Withington
Hereford
HR1 3QG
Tel. (01432) 850 692
www.hortechsolutions.co.uk
(P)

LS systems
184 Blackgate Lane
Tarleton
Preston
PR4 6UU
Tel. (01772) 812 484
www.lssystems.co.uk
(C)

Meteor Systems
Minervum 7081
4817 ZK Breda
The Netherlands
Tel. +31 (0)765 04 2842
www.meteorsystems.nl/en
(F)

Northern Polytunnels
Mill Green
Waterside Road
Colne
Lancashire
BB8 0TA
Tel. (01282) 873 120
www.northernpolytunnels.co.uk
(F), (P), (C)

Priva UK Ltd
34 Clarendon Road
Watford
WD17 1JJ
Tel. (01923) 813 480
www.priva.com/uk
(F)

Pro Tech Marketing
Severn View
Buildwas Road
Ironbridge
Telford
TF8 7BN
Tel. (01952) 433 123
www.pro-tech-marketing.co.uk
(P)

Wroot Water Ltd
Thatch Carr Farm
Field Lane
Wroot
Doncaster
DN9 2BL
Tel. (01302) 771 881
www.wrootwater.com
(F)