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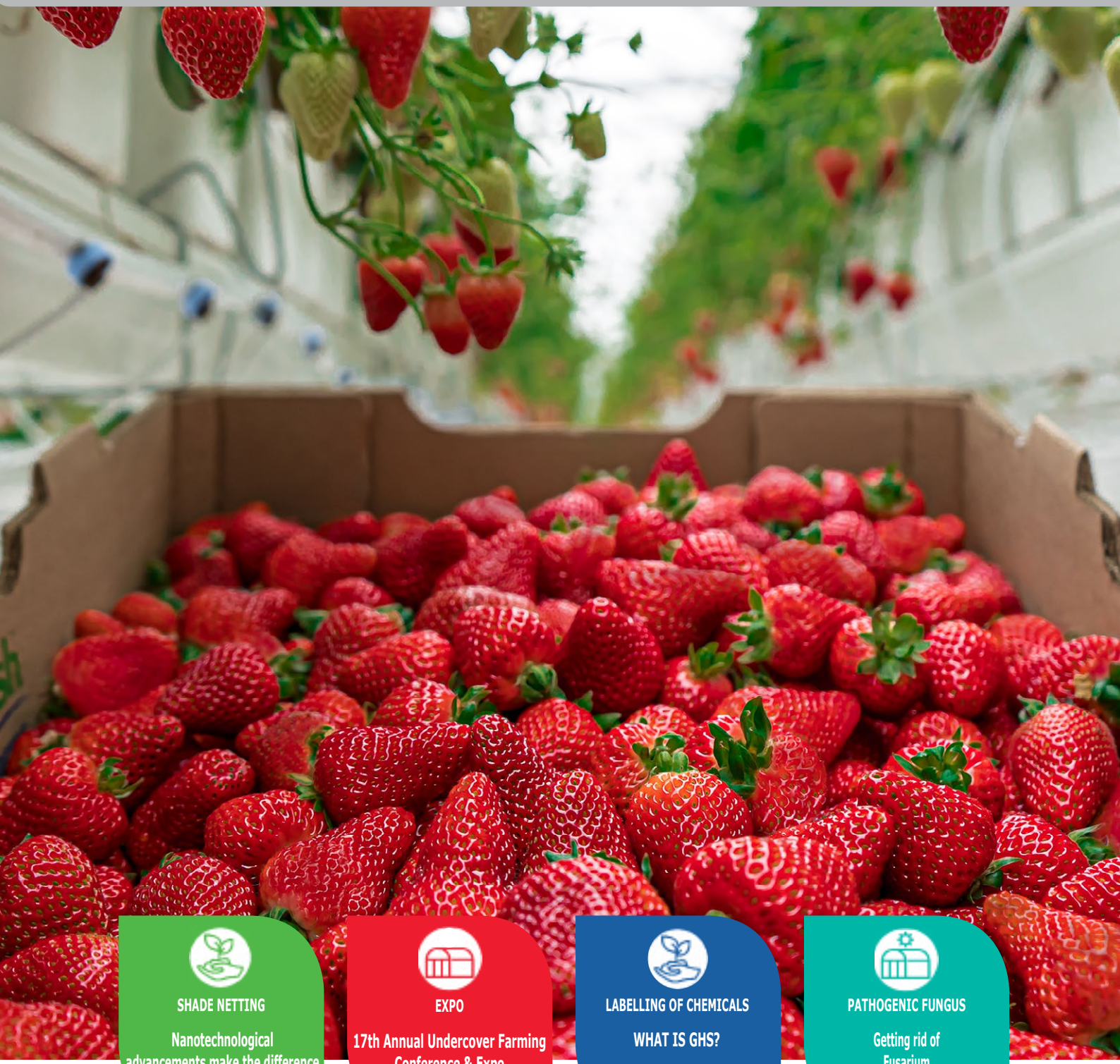

NANOTECHNOLOGICAL advancements make the difference

The range of nets recommended by Meiring include nets woven in South Africa by Standerton Mills, nets especially woven according to Meiring's specifications in China and finally those that make use of Spanish net technology.

The critical thing of which many farmers are not aware is additives to the yarn, and additives make a gigantic difference to the effectiveness and lifetime of the net, he says. Sulfur and copper sprays can influence the normal additives used to protect high-density polyethylene (HDPE) against ultraviolet radiation, so specific additives are used for extra protection against the South African sun. Sunburn is a major problem experienced by farmers in the Western Cape, and enquiries are streaming in from farmers who are looking to replace their current inadequate nets, sometimes expensively imported nets that cannot cope with local conditions.

Ultraviolet radiation breaks down the net's polyethylene fibers, but the Spanish technology employs nanoparticles of aluminium to absorb and refract much of the infrared radiation back into the atmosphere. "We realized that when you have the right additive in the net yarn, you can effectively manage sunburn without a negative impact. In the citrus industry, farmers have found that even under white nets, they're still getting sunburn. Since we started using the right additives to manage infrared rays, the fruit is cooler under the net than outside, and we've been seeing dramatically greater sun protection."

Sweet pepper farmers in Limpopo find their nets far preferable to the traditional plastic tunnels during the hot summer months.

Realizing a thirty percent reduction in irrigation needs in a covered orchard is no problem, and when less irrigation is required, it also translates into costs on electricity too.

"For me, the very worst thing is when the most attractive fruit gets damaged while it's hailing," he says. "You can't be spending thousands of Rands and then you still have fruit with marks that have to be downgraded from class one, or after a heavy hailstorm you're sitting with extensive damage. So, my advice to farmers is: let's do it a bit differently, a bit better. It's worth it for a long-term investment as this is."

Hard lessons have been learned to perfect net structures

They also designed a clip so that nets can quickly be opened and bunched up ahead of a snow forecast (no nets can really protect against snow, he says)

The impact of nets on bees' pollination activities cannot be overestimated, he notes, and because bees navigate by polarized light, they can be completely thrown off kilter by the way light filters through some nets. Therefore, stonefruit and topfruit farmers will keep the orchards open until pollination has been completed and then cover up the orchards for the rest of the season.

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SCRIPTURE

A lazy man's farm is the breeding ground for snakes. A patent on seeds is a patent on freedom. If you must pay for patented seeds, it's like being forced to buy your own freedom. A plant is like a self-willed man, out of whom we can obtain all which we desire, if we will only treat him his own way.

ucf Undercover

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Survival is currently the most often discussed subject by food producers. The question arises; what has happened to a free and fair trade and production system, without glitches like electrical and water supply shortages, dysfunctional export systems and other curtailments towards progress in food production? South Africa for many decades was on the forefront of quality produce, continuous flow towards markets and exports of note to many foreign destinations? Do we have to blame the 'wheel and deal' players in politics and foreign suppliers only? Napoleon Hill wrote a book, 'Think and grow rich'. It is possibly time as role-players in agriculture to look beyond the current barriers. New technologies like electronification, solarisation and a myriad of latest, well-researched and trialled technologies are available to producers. It is a question of good financial planning, utilizing every possible strategy in the business and moreover, obtaining finance from the right institution. Government can no more 'look the other way' when it comes to export taxes, no assistance towards energy, water, fuel and fertilizer costs in agriculture in the broad. Neighbouring state governments are all assisting producers with these important input expenses so their production levels can increase. We would like our government to look into these aspects and not fall behind their neighbours. With winter on hand, growers juggle their climate control, water supplies and possible greenhouse plant pests. We do our best to publish editorial content of relevance to the current season and hope this will stir feedback to the editor from producers who wish to know more on these subjects. Happy reading!

STRAWBERRY FARMING:

TIPS FOR SUCCESS

Farmers who intend to grow and be successful at growing strawberries. Should plant the correct variety at the right time and follow the growing tips in this editorial.

There are two main types of strawberries farmers should select from. They are Spring Bearing (Short-Day) Strawberries, for example Selecta. Its planting time is in Autumn (end of March to end of May) and its flower and fruit time, Spring (September to December).

The second is Everbearing (Day Neutral) Strawberries for example Aromas. Its planting time is any time of year (for best results, from end of March to end of August). Its flower and fruit time; any time of the year under ideal growing conditions.

Strawberry seedling growers like Helderberg Farm sells both Spring Bearing & Everbearing Strawberry Plugs. One should keep in mind to plan forward and in order to ensure that the farmers receive their required quantities, order should be placed well ahead and before the end of November.

Spring Bearing plugs are only sold from the 20th of March until 30th of April. Everbearing plugs are sold from the 20th of March until the 31st of August.

Advice to smaller growers
The following information may help you to successfully grow strawberries. These guidelines will help you to know how and when to plant in your specific location.

Ideal Climate –
Optimal temperature for flowers & fruit development is 15 – 28°C. Minimum sunlight of 6 – 8 hours per day. During hot summers, you need the perfect balance of sunlight & shade. Morning sun and afternoon shade is preferable.

Always keep good ventilation and direction of prevailing winds in mind when planning a structure. Temperatures of below zero can be withstand under certain conditions.

Challenging Climatical Conditions: Cold wet winters with hot summers / Frost / Dry winters with hot wet summers. It is

suggested for Cultivar choice / Use of straw / Frost net / Low tunnels / Shade net (40-60%) to plant from mid-October until end of March.

Choosing the ideal variety
There are 2 main types of strawberry varieties available: Spring Bearing (Short Day Varieties): Flower initiation requires a day length of less than 12 hours. Selecta & Chandler is well known in South Africa. Selecta is one of the best choices for root / leaf / fruit disease resistance.

Everbearing (Day Neutral Varieties) for example Aromas: Flower & fruit throughout the year under ideal conditions.

Planting Time
Advice for Spring Bearing Varieties: Plant your plugs/seedlings as soon as the extreme summer heat ends (end of March to end of April). Plants need to develop as much as possible before the cold weather sets in. Flowering should start in July/August under ideal conditions.

Everbearing Varieties: Plant your plugs/seedlings from end of March until end of August for best results. Under ideal conditions, the earlier it's planted, the earlier it'll start bearing fruit. In mild winter areas, staggering your planting dates every 4-6 weeks will ensure an extended peak harvest.

Plants from containers other than plugs/seedlings purchased during winter can be planted throughout winter months, even early spring, for they are already well developed.

Plants from containers other than plugs/seedlings purchased during summer are planted as normal. If they do not flower, wait until the first week of April, then cut back all old growth and fertilize. It should grow out and flower as normal. Shade net can be helpful against hot sun.

Harvesting strawberries
With Spring Bearing Varieties fruiting starts in August/September & peak in mid-October/November. Crop should be around 500 grams per plant or more. The crop is concentrated in about 10 to 12 weeks.

With Everbearing Varieties fruiting starts around 3 months after planting. The crop should be around 500 grams or more over the extended period of 6-8 months, depending on conditions. Staggered planting will extend your peak harvest.

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GREENHOUSE FARMING to feed nations – even under adverse conditions

Iceland has unique conditions and natural resources that potentially allow a very sustainable production of food in greenhouses for export to the world. Wageningen University & Research (WUR) has analysed the greenhouse technology required, the costs and resource use for the crop production and the potential markets that could benefit from this export.

The study shows a methodology to analyse crop choice, technology selection and market assessment for protected cultivation at the example of Iceland. The methodology can be applied at any other region in the world.

Feed the world in the 21st century
The largest challenge of agriculture in the 21st century will be to feed a world population that is expected to grow by 2 billion people between 2020 and 2050 (UN,2019a). Urban areas will host 68%of the world population by then (UN, 2019b). The projections show that feeding that amount of people would require raising overall food production by some 70% between 2005/07 and 2050 (FAO, 2009).

Open land agriculture under threat
The threat posed by climate change on open field agriculture is very worrying because we see a clear increase in the episodes of drought, floods, higher incidence of pest and diseases, fires, etc.

This brings more opportunities for controlled environmental crop production, which can increase yield per unit area of

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Planting Method
Plant the seedlings in a row spacing of 30 – 35 cm. Narrow spacing may decrease ventilation and increase risk of diseases. Planting depth must be just below the crown (the part where new leaves and flowers are formed). Roots must be covered with soil (exposure may lead to stress, disease / stunted growth). Mulching will restrict water loss, as well as keeping soil cool, prevent weeds and keep fruit clean.

Soil, Fertilizing & Seedbeds
Strawberries can be planted directly in soil / on raised beds / planter boxes pots / hanging baskets / hydroponics. Use the same direction for seedbeds & structures as prevailing winds for maximum ventilation. A raised bed will help with water run-off to prevent over irrigation. Use deep, well drained organic soil. Maintain pH of 5.5 to 6.5. Compost tea every 7-10 days will help keep soil and roots healthy and will result in better disease resistance.

Strawberries do well in compost rich soil. Use only well matured compost with low salt content. Use chemical fertilizer wisely. The shallow root system is highly sensitive for saline soil. Regular foliar sprays will help balance nutrient supplies and lead to healthy disease resistant plants. Young leaves should have a healthy dark green colour. Regular feeding in small quantities is key.

Managing irrigation
Water management is crucial. Keep plant roots moist, but not too wet. Leaves should be kept dry. Drip irrigation (A timer is a valuable tool) is a preferable option.

Dry periods will damage the shallow roots and result in root rot / diseases. Remove all flowers, runners and old leaves until the plants are well established with new growth of 5-8 leaves.

Continue removing runners, discoloured leaves, and rotten fruit. This will stimulate new growth and flowers. Do not add the debris on your compost heap. Fertilize, foliar feed and add compost tea regularly. Ask your local nursery expert about slow-release fertilizer.

Managing pests and diseases
Always remember; Prevention is better than cure. Reduce stress factors such as too deep planting, reduced sunlight hours, bad sanitation (rotten fruit & sick leaves), poor ventilation, dry periods, continuous overhead irrigation / rain, waterlogging, temperature stress & weeds.

A healthy stress-free plant has a better chance to resist leaf / fruit / root diseases. Pests such as red spider, caterpillars, centipede, aphids, thrips / snails may also be a challenge, ask your local nursery expert for advice.

Plant replacement –
Due to the harsh climate in South Africa, you may find it worthwhile to replace your strawberry patch annually with quality plant material.

Source: Helderberg Farm supply quality Strawberry Plugs, Plants, Seedlings to home gardeners, small growers, farms and nurseries across South Africa.

<< GREENHOUSE FARMING From page 5

land, with very high independence of the external factors in any world location. Controlled Environment Agriculture is able to provide high-value, fresh, vitamin and mineral-rich products.

Next to that, controlled environment agriculture is very efficient in the use of resources (CO2, water, fertilizers, etc.), however more intensive in the use of energy and therefore needs to become even more green and circular.

Iceland example

This may open the opportunity for world territories which, nowadays, play a minor role in production and export of crops to the world, but which have both land and large sustainable resources for a green and circular Controlled Environment Agriculture.

An example of this could be Iceland, which despite of its northern latitude, has some unique characteristics which might make the island a good candidate for the establishment and operation of protected crop production:

- It has abundant (almost) inhabited land.
- It has an unlimited supply of renewable energy (mostly geothermal and hydroelectric).
- Its climate is milder than that in other zones with similar latitude, thanks to the Gulf stream.

Therefore, the questions are:

- Can Iceland host giga scale factories for crop production and export to different world markets?
- Which crops could be produced competitively at a giga scale?
- How can productivity be improved by the technology of the growing system?
- How is resource use affected by climate?
- Which export markets are most suitable?

Collaborative effort

To answer these questions, research has been carried out by WUR's Business Unit Greenhouse Horticulture and Wageningen Economic Research in collaboration with Earth 2.0:

Selection of 8 different crops representing mineral- and vitamin-rich fresh crops and fruits, calorie- and protein-rich tubers and cereals. This task has been accomplished by adapting and applying a crop selection tool earlier proposed by Dueck et al. (2016).

Different technical greenhouse and indoor factory designs and calculation of their resource use have been considered. For this, the adaptive greenhouse methodology developed by Vanthoor (2011) has been applied.

This methodology makes use of a powerful simulation model named Kaspro to obtain accurate predictions of the greenhouse indoor microclimate, the required amount of some key resources (water, energy, CO2, etc.) for production in both greenhouse and indoor factories (de Zwart, 1996) as well as crop growth simulation models such as Intkam for tomato (Marcelis et al., 2006) and lettuce (van Henten et al., 1994) and photosynthesis data from different scientific publications to predict potential crop yields of several other crops.

This has been done for 89 different scenarios.

Cost price for produced food crops has been calculated. Data have been retrieved from different sources (Iceland, The Netherlands, etc.) to make the OPEX and CAPEX analysis and obtain the cost price for each studied scenario using the methodology used in the elaboration of the KWIN (Raaphorst et al., 2019).

Market selection for food crops and data collection: a market selection tool (Market explorer) has been used by Wageningen Economic Research to select the most interesting 8 export destination markets (as well as the internal market) for export

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of the 8 selected products, making a total of 64 possible combinations.

After selection of the destination markets, for each product-market combination data has been obtained on wholesale and transport prices. Also, import levies have been considered. The internal Icelandic market was also studied.

The main conclusions are:
There is room for feasible production in giga-scale high tech greenhouse facilities to satisfy the demand of the domestic market in Iceland for most products studied, except for cheap commodities (rice, potato, wheat).

Greenhouse production (using natural sunlight and artificial light sources) should be preferred to indoor factory production (artificial light sources only).

In the case of indoor farms, only lettuce is suitable to ensure a profit. We might assume that perhaps also other leafy greens and/or aromatics and herbs might be suitable.

The analysis also indicates that there are no major differences in operating giga farms between the South and the North coast of Iceland, since in terms of greenhouse crop production design perspective the outdoor climate is relatively comparable, except that there is more snowfall in the North.

Necessary equipment for control of crop growing conditions is comparable.

To export fruits or staple crops like wheat large volumes are required to fill containers and to export fruits serious additional investments are required in packhouses.

The combined analysis of cost/benefit and market indicates that there are three groups of crop products:

One group, composed of highly productive mineral and vitamin-rich crops with a large water content (lettuce, tomato, sweet pepper), are close to a profit.

However, the main bottleneck in almost all analysed combinations is the high transport prices by airplane since short post-harvest life of the products will not allow boot transport.

A rational boost of production and decrease of resource potentially obtained using automated control by e.g. artificial intelligence algorithms in the future could bring these products closer to benefit, but high transport cost would remain a burden to build feasible business cases.

Another group, represented by calorie- and protein-rich products with low productivity per unit area, which have a large dry matter content (rice, potato, banana, avocado and wheat), do not show any profitable production in a protected environment.

The reasons are their low productivity per unit area and the cheap price in the destination markets, given the large supply of these products from open field cultivation worldwide and possibilities for long term storage.

There is also steep competition for these products of a few dominant producers (for example in banana trade).

A final group represents products for which combinations of nearby market and high destination value could lead to clear profit (i.e. raspberries in the USA and to a lesser extent, in the UK). However, the profit margin is still relatively low (about 12%) and this is below the industry standard.

In this group, again, lowering transport costs would allow for more positive combinations.

The use of automated control by e.g. artificial intelligence algorithms in the future or a decrease in the price of the major operational costs (i.e. electricity) would help in improving the cost/benefit balance.

Methodology in different countries
The study presented here for Iceland shows a methodology and use of available WUR tools, ready to be used for other regions and markets in the world. Protected cultivation (from low-tech simple tunnels to high-tech controlled environment greenhouses up to indoor factories) is becoming important to produce fresher, vitamin- and mineral-rich food in the future in the scope of climate change.

The use of sustainable resources such as energy (e.g. geothermal and hydro-energy) and the potential for extremely high-water efficiency make these systems more and more attractive.

However, the economic viability is largely depending on the target market and product prices and on the shelf-life of products and transport costs. The methodology shown here helps to quantify different production systems for different crops and markets.

This study was carried out by the Wageningen Research Foundation (WR) business unit Greenhouse Horticulture and was commissioned and financed by Earth 2.0 EHF and David Wallerstein.

Economies of scale is a term used to describe decreasing average cost of production (for example, the cost of producing a kilogram of cannabis) asa grower's total output increases. It furthermore prevails if unit costs fallas output increases (if the elasticity of costs with respect to the grower's outputis less than one).

ECONOMIES OF SCALE IN THE PRODUCTION OF CANNABIS

Economies of scale might be realized either if there are diminishing marginal costs or if there are fixed costs of production (fixed costs such as capital equipment and plant construction are spread over a larger scale of output). Economies of scale might also result from improvements in organizational structure, productivity gains from labour specialization (with a higher output, workers can specialize more narrowly on specific tasks that they may better perform than if they devoted only a small share of their time to that task), and technology improvements.

According to authorities about cannabis production, organized crime groups are running networks of houses and overseeing high-quality operations in terms of lighting, ballasts, layout, etc. These groups are employing professional electricians, greenhouse staff and at each step, as compared with the medical access point's providers who appear less sophisticated by comparison, with many doing their own construction and design (the consequence being a less sophisticated set-up).

Few of these are economically viable because of their lower production versus income, notwithstanding their expense on labour and input costs.

Even today's small producers might want to hire the 'professionals' currently employed by organized crime groups, if they dare to risk their businesses and lives in turning to these for help.

Although much focus is put on internal economies of scale (the change in costs a grower would experience because of an increase in his output) - cannabis growers may also benefit from external economies of scale. This in which increases in the output of an entire industry's produce marginal cost savings of the total industry, against decreasing the average costs of production for many businesses all at once.

External economies of scale exist if growers benefit from being close to other growers. These take the form of labour pooling, sharing common assets, better availability of intermediate inputs, and sharing know-how.

An important external effect for growers might be shared enforcement risk (governmental enforcement is more difficult as the number of growers increases).

For some external economies of scale, it does not matter whether growers can communicate (e.g., for enforcement swamping) but for other external economies. What may matter is not only the total number of growers in the area, but also the ability of those growers to trade information, expertise, share suppliers, etc.

If economies of scale are present, estimating the magnitude of the scale effects is important for informing decisions regarding the optimal number of licenses to issue. If the economies of scale are very large, and persist indefinitely for larger and larger operating scales, then growers producing at a large scale might exclude small-scale farmers from successfully competing.

Economies of scale therefore have implications for the number(and size) of growers that would be feasible in an unregulated market. This hasimplications for costs, price, product variety, and regulatory burden.

Strongeconomies of scale would favour large growers, an oligopolistic market structure, and concentrated production; accordingly, they may strengthen the arguments for policies intendedto mitigate those outcomes. Another reason to pay attention to economies of scale is that they affect the severity of the legalization-induced price decline, which in turn affects regulators'ability to drive the illegal market out of business as well as combat likely associated increases in use and abuse.

From a study on the economic viability of producing cannabis in greenhouses by Botec Analysis Corporation. A commercial outfit with modern technology in place.

The small cannabis greenhouse operator.

17TH ANNUAL UNDERCOVER FARMING CONFERENCE & EXPO: A CORNERSTONE FOR PROFESSIONALS IN THE GREENHOUSE AND SHADE-NET FARMING SECTORS

Secure your seat by Booking TODAY!

The 17th Annual Undercover Farming Conference & Expo is set to take place on 29–30 October 2025 at the scenic Allée Bleue Wine Estate in Groot Drakenstein, Western Cape. This premier event has become a cornerstone for professionals in the greenhouse and shade-net farming sectors, offering unparalleled opportunities for learning, networking, and business growth.

■ Why This Event Is Essential for All Stakeholders in Protected Agriculture

1. Comprehensive Coverage of Protected Farming Techniques

The conference delves into various facets of protected agriculture, including greenhouse farming, hydroponics, aquaponics, and shade-net cultivation. Attendees will gain insights into innovative techniques and technologies that enhance productivity and sustainability in controlled environments.

2. Expert-Led Sessions.

Benefit from a comprehensive program featuring internationally acclaimed speakers and industry experts. Topics will cover a wide range of subjects, including greenhouse construction, fertigation, soil health, pest management, automation, harvesting, and packaging. These sessions are designed to provide practical knowledge that you can apply directly to your operations.

3. Networking Opportunities

Connect with a diverse group of professionals, including farmers, seed companies, horticulturists, irrigation specialists, retailing companies and more. The expo floor will feature leading exhibitors showcasing the latest products and technologies in protected agriculture. Forge valuable partnerships and discover new opportunities to grow your business.

4. Access to Latest Products and Technologies

Explore a wide range of products and services from leading exhibitors specializing in greenhouse structures, climate control systems, irrigation equipment, and more. This is an excellent opportunity to discover new tools and technologies that can enhance your farming operations.

Embrace the Future of Sustainable Agriculture

With increasing concerns about climate change and resource scarcity, the expo emphasizes sustainable farming practices. Learn about water-saving techniques, renewable energy solutions, and eco-friendly inputs that can reduce your environmental footprint while maintaining high yields.

SECURE YOUR SPOT TODAY

Don't miss this opportunity to be part of a transformative experience that will shape the future of protected agriculture in South Africa and beyond. Spaces are limited, and early registration is highly recommended.

■ Register now at https://undercoverfarmingexpo.com and take the first step towards elevating your greenhouse farming practices.

Join us in cultivating innovation and driving excellence in protected agriculture!

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WHAT IS GHS? - GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS

The Globally Harmonized System of Classification and Labelling of Chemicals, developed by the United Nations and commonly referred to as the "GHS", is an internationally harmonized approach to classifying and labelling of chemicals, and conveys the hazards associated with a chemical in a standardized way. The need for GHS arose because of the global trade of chemicals, which often cross boundaries into areas with different languages and varying levels of literacy, thereby creating challenges when communicating safe and responsible usage instructions of the products. It is hoped that such an approach will contribute to the safe use, transport and disposal of chemicals, and assist countries in developing the appropriate infrastructure to control chemical exposures and ultimately protect people and the environment.

The most noticeable changes brought by GHS is the way in which the chemical is classified and how this information is conveyed to the user, resulting in changes to the labels and safety data sheets (SDS's) of chemicals. It is important to note that even though the label and SDS of a chemical has changed, the hazards associated with the product did not change, only the way in which these hazards are communicated. In South Africa, GHS became a legal requirement for all hazardous chemicals from September 2022 with the promulgation of "The Regulations for Hazardous Chemical Agents" No. R280 under the Occupational Health and Safety Act, 1993, on 29 March 2021. An extension for implementation was later provided to 30 September 2023, with these changes still being phased in.

The requirement for GHS for agricultural remedies specifically, is also included in the "Regulations relating to agricultural remedies" promulgated on 25 August 2023 under the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947).

HOW DOES IT WORK?

It is very important for farmers, farmworkers and anyone handling a chemical to understand how GHS works, because the hazards associated with a particular chemical, their nature and severity, are communicated

through several elements, such as hazard statements, pictograms and signal words on both the label and the safety data sheet of the product. It is only when we understand the hazards associated with a chemical that we can effectively mitigate the risks.

First, let's have a look at the classification criteria of these hazards. According to the GHS, the nature of a hazard is assigned according to a hazard class, of which there are currently 29. Seventeen (17) of these are physical hazard classes, such as oxidizing liquids, 10 are health hazard classes such as skin corrosion/irritation, and two are environmental hazard classes, namely hazardous to the aquatic environment or hazardous to the ozone layer. Not all of these hazard classes will be commonly associated with agricultural remedies, however.

Within these classes, the severity of the hazard is then allocated in terms of a hazard category expressed as a number, for instance category 1 would be the most severe. Category 2 would be less severe than category 1 but more severe than category 3, and so forth. Some of these categories are further sub-divided into divisions, which are expressed as a letter, i.e. A, B, C, etc.

The GHS also uses hazard statements, pictograms and signal words to communicate the hazard of the chemical, as well as precautionary statements to mitigate any potential risks. These are all linked to the hazards that have been identified.

For example, when considering the health hazard "carcinogenicity", category 1 is a "known or presumed human carcinogen", whereas category 2 is a "suspected human carcinogen". Category 1 is however further divided into category 1A and category 1B; the former being known to have carcinogenic potential for humans and is largely based on human evidence, whereas the latter is presumed to have carcinogenic potential for humans and is largely based on animal evidence.

Table 1: Hazard classes covered under the GHS

Physical hazards	Health hazards	Environmental hazards
Explosives	Acute toxicity	Hazardous to the aquatic environment
Flammable gases	Skin corrosion/irritation	Hazardous to the ozone layer
Aerosols and chemicals under pressure	Serious eye damage/eye irritation	
Oxidizing gases	Respiratory or skin sensitization	
Gases under pressure	Germ cell mutagenicity	
Flammable liquids	Carcinogenicity	
Flammable solids	Reproductive toxicity	
Self-reactive substances and mixtures	Specific target organ toxicity – single exposure	
Pyrophoric liquids	Specific target organ toxicity – repeated exposure	
Pyrophoric solids	Aspiration hazard	
Self-heating substances and mixtures		
Substances and mixtures which in contact with water emit flammable gases		
Oxidizing liquids		
Oxidizing solids		
Organic peroxides		
Corrosive to metals		
Desensitized explosives		

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Hazard statements

Hazard statements are phrases that describe the hazard/s as determined by the hazard classification. They start with the letter H followed by three numbers. For physical hazards, the statement will start with H2 (followed by two additional numbers), health hazards start with H3 and environmental hazards with H4, for example H300: Fatal if swallowed. These hazard statements appear both on the label as well as the safety data sheet, however the code (i.e. Hxxx) only needs to appear on the safety data sheet and not on the label.

For example, for the health hazard "Carcinogenicity", the hazard statement for a category 1A or category 1B carcinogen is "H350: May cause cancer". For a category 2 carcinogen, the hazard statement is "H351: Suspected of causing cancer".

Precautionary statements

Precautionary statements are linked to the hazard statements and are used to explain how to handle these substances, as well as which precautions to take to ensure any risk associated with handling the product is mitigated.

The precautionary statements are preceded by the letter P and three numbers that are also categorized according to type, similar to the hazard statements.

For instance, general statements will start with P1 followed by two numbers, prevention statements with P2, response statements P3, storage statements P4 and disposal statements with P5, e.g P264: Wash hands thoroughly after handling.

These statements appear on the product label and the safety data sheet. As with the hazard statements, the codes (i.e. Pxxx) are only required on the safety data sheet and not the label.

For example, for the health hazard "Carcinogenicity", the following precautionary statements should be included on the product label and SDS:

• Prevention
- P203: Obtain, read and follow all safety instructions before use.
- P280: Wear protective gloves/protective clothing/eye protection/face protection (whichever applicable based on usage instructions).

• Response
- P318: IF exposed or concerned, get medical advice.
• Storage
- P405: Store locked up.
• Disposal
- P501: Dispose of contents/container in accordance with local regulations.

Signal word

Based on the hazards identified and the corresponding categories and thus severity thereof, a signal word is used to describe the hazard. The signal word "Danger" is used to describe more severe hazards, and the signal word "Warning" is used to describe less severe hazards.

A chemical will only include one signal word which will be the most severe signal word flagged during the hazard classification.

For example, if a mixture is classified as a category 1A carcinogen, the resulting signal word on the label should be "Danger". The same mixture is also classified as being a category 1A skin sensitizer, for which the signal word "Warning" must be used. Because "Danger" is the most severe signal word flagged for the hazards associated with the chemical, "Danger" will be the final signal word included on the label.

Pictograms

A pictogram is a graphical representation of the hazards associated with the chemical and is associated witha specific hazard class and category. All pictograms prescribed by the GHS have a black symbol on a white background with a red frame. Except for the exclamation mark, all pictograms flagged by the hazard classification must always be included on the label and SDS of the chemical.

For example, if a chemical is classified as a category 1A carcinogen and a category 1A skin sensitizer, the health hazard pictogram is flagged by the former and the exclamation mark pictogram by the latter. Both the health hazard and exclamation mark pictograms will be included on the label and SDS. However, if the chemical was classified as a category 1 respiratory sensitizer, flagging the health hazard pictogram, and a category 1A skin sensitizer flagging the exclamation mark pictogram, the exclamation mark pictogram that was flagged for skin sensitization will not be included on the label and SDS, only the health hazard pictogram. Both these hazards relate to sensitization and the health hazard pictogram indicates a more severe sensitization hazard than the exclamation mark.

Table 2: Pictograms used by the GHS to indicate physical, health and environmental hazards.

WHAT CHANGED ON THE LABEL?

In the past, agricultural remedies were classified and labelled according to the World Health Organization (WHO) recommended classification of pesticides by hazard. This system classified the remedy based on the acute oral and dermal toxicity of the active ingredient(s), which was reflected in the colour band at the bottom of the front panel of the label. Pictograms on the colour band provided information on the personal protective equipment required and general precautions to take when storing, handling, or applying the remedy. A corresponding word based on the severity of the toxicity was included on the colour band (Caution, Harmful or Toxic). With the implementation of the GHS, the most noticeable change to the label of an agricultural remedy is the removal of the colour band and corresponding pictograms, and the inclusion of the GHS hazard pictograms, hazard statements and precautionary statements. The GHS covers more hazards than the previous WHO system and classifies the remedy based on physical, health and environmental hazards, not just acute toxicity, and considers the active ingredient(s) as well as the inert ingredients in the formulation. Consequently, the GHS is a lot more comprehensive in terms of hazard classification and communication than the WHO system. As mentioned, it is important to note that even though the label and SDS of a chemical have changed, the hazards associated with the product did not change, only the way in which these hazards are communicated.

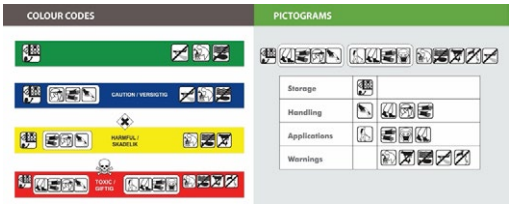


Figure 2: Example of the colour bands and pictograms used on agricultural remedy labels when using the WHO recommended classification of pesticides by hazard.

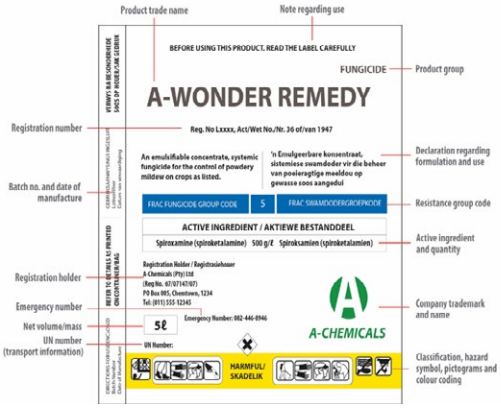


Figure 1: Example of an agricultural remedy label where the remedy has been classified and labelled according to the WHO recommended classification of pesticides

▶ 12

<<< WHAT IS GHS? from page 11

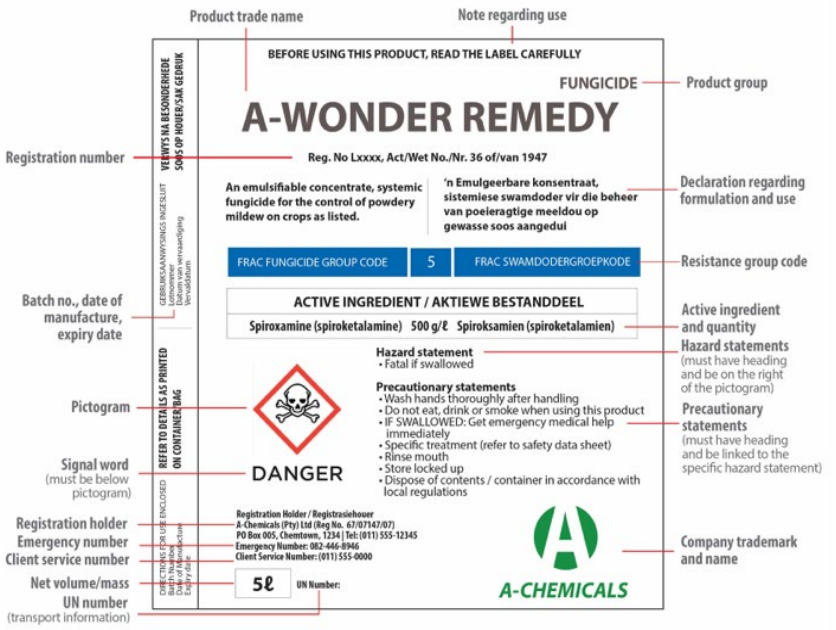


Figure 3: Example of an agricultural remedy label where the remedy has been classified and labelled according to the GHS.

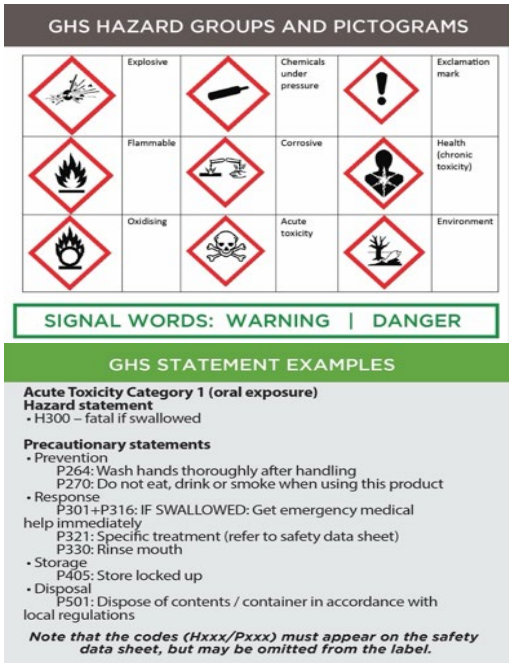


Figure 4: Example of the hazard pictograms, hazard statements and precautionary statem ents used when classifying and labelling an agricultural remedy according to GHS.

WHO recommended classification of pesticides by hazard	GHS
The acute toxicity of the active ingredient(s) is used to classify the remedy.	All ingredients in the formulation are used to classify the remedy.
Only acute toxicity is considered.	Acute toxicity is considered along with chronic toxicity, as well as other health hazards, physical hazards and environmental hazards.
Only oral and dermal exposure is considered for acute toxicity.	Apart from oral and dermal exposure, exposure by inhalation is also considered for acute toxicity.
A colour band with precautionary pictograms and a word describing the acute toxicity of the product is included on the front panel of the label to communicate the potential hazards associated with the remedy.	Hazard pictograms, hazard statements, precautionary statements and a signal word is used to communicate the potential hazards associated with the remedy.

CHANGES TO THE SAFETY DATA SHEET

Safety Data Sheets are produced for all substances and mixtures which meet the harmonized criteria for physical, health or environmental hazards under the GHS and for all mixtures which contain ingredients that meet the criteria for specific chronic hazards in concentrations exceeding the cut-off limits provided in the GHS. These documents are no longer referred to as Material Safety Data Sheets (MSDS), but merely as Safety Data Sheets (SDS). Safety Data Sheets as composed under the GHS has a standard format, providing information on the chemical under 16 headings:

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

It is important to read and understand all the information provided in the SDS before using a hazardous chemical.

HAZARD VS RISK

The degree of a chemical's capacity to harm depends on its intrinsic properties, i.e. its capacity to interfere with normal biological processes, and its capacity to burn, explode, corrode, etc.

The concept of risk or the likelihood of harm occurring, and subsequently communication of that information, is introduced when exposure is considered in conjunction with the data regarding potential hazards. The basic approach to risk assessment is characterized by the simple formula:

hazard x exposure = risk

Thus, if you can minimize either hazard or exposure, you minimize the risk or likelihood of harm occurring.

The GHS's aim is to communicate the inherent hazards of the chemical, and because of these hazards, there are certain risks involved with working with the product, but these are mitigated if the label instructions are followed.

Just because a product is hazardous, does not mean it cannot be applied safely. A vehicle, for instance, can also be a hazard if you consider the number of accidents on the road, but we don't just ban vehicles altogether because of this.

Instead, we mitigate the risk by wearing a safety belt, adhering to the speed limit and following other road safety regulations. The same logic applies when working with hazardous chemicals, which is why understanding the product label and safety data sheet is so important.

And remember, any application of a crop protection product in any manner other than the label instructions is a contravention of the law, so do the right thing and make sure you, and any person working with you, know exactly how to use these products safely and responsibly.

Source: www.croplife.co.za | info@croplife.co.za | +27(0)87 940 4168

The rapid expansion of citrus plantings across South Africa will have a definite and significant impact on the South African citrus industry. Whether markets will absorb the increased fruit supply and what the subsequent repercussions on the current profit margins in the next five to ten years will be, is unclear and somewhat unsettling.

CITRUS PRODUCTION under shade net progressive

Another more worrying problem is the issue of climate change and its effects on citrus production. During the past few years, high temperature extremes have increased, while low temperature extremes have decreased significantly.

Some of the warmest monthly temperatures were recorded back in the 2015/16 season, but even higher temperatures and more frequent warmer days are predicted. Small fruit size problems will increase, as well as orchard water usage (~10% by 2050), and fruit cosmetic damage due to wind, hail, and sunburn a major possibility.

Planning ahead

Long-term strategic planning and embracing the latest research findings and subsequent novel on-farm technologies, became the main determinate of producer progress and competitiveness in the industry. Shade netting is one such technology that could provide significant solutions to fruit quality related problems, as well as increase producer competitiveness in future potentially saturated markets.

Shade nets already made its mark in citrus production in areas traditionally considered unsuitable for production of citrus, as well as buffer against negative impacts of climate change.

SHADE NETS IN CITRUS PRODUCTION

The use of shade nets is a familiar commercial agriculture practice – specifically for use in tree nurseries and the production of annual fruit crops, but more recently also in perennial fruit trees. The most desired effects from shade netting are reduced light intensity and wind speed, as well as buffering of temperature extremes and increasing relative humidity.

Desired plant responses include hastened plant vegetative development, fruit protection against cosmetic damage by wind, hail and sunburn, as well as protection against damage by birds.

Prominent findings on the effects on orchard micro-climate include increased minimum and reduced maximum temperatures, an increase in relative humidity, and up to 85 to 90% reduction in wind speed. Shade nets increase leaf stomatal conductance during hot summer days (a factor of transpiration and sap-flow) by reducing photo-inhibition caused by extreme irradiation and mitigating the mid-day depression.

In terms of horticultural plant responses, shade nets favour the development of vegetative tissues (shoots and leaves) instead of reproductive and root growth (measured in seasonal gain in dry mass). .

However, in experiments on 'Orri' mandarin trees, shade nets resulted in an up to twofold increase in fruit yield (kg fruit per tree) and significantly increased tree water usage efficiency (WUE) and fruit quality. Between red (25%), yellow (24%), white (18%) and transparent (13%) shade nets, trees under 18% white nets consistently performed better.

Trees under dark nets (red and yellow) exhibited increased vegetative growth and reduced yield, while water consumption under dark nets Important considerations for citrus production under shade nets This article combines all the important and available information on shade nets, to provide citrus producers some background on the use of shade nets in a South African context.

EXPERIENCES OF PRODUCERS

In September 2015, Riaan Van Zyl of Loveren Boerdery outside Kakamas, planted 35 hectares of 'Nadorcott' mandarin trees – 12.5 ha under permanent 20% white nets and 12.5 ha outside. During spring and summer, they struggled with very strong winds and were forced to consider erecting permanent netting structures over some of their new plantings of high-value cultivars. Young trees under nets grew almost double in size, compared to those outside.

Permanent shade nets vs drape nets

A nearby farmer, Junior Aggenbag, erected 6,5-metre-high permanent shade nets over some of his 'Star Ruby' grapefruit and 'Nadorcott' mandarins. During spring and summer, they first apply foliar nutrient and pesticide sprays to orchards under nets, because there are almost no winds. Shade nets increased his pack-out of 'Star Ruby' by 12% due to reduction in sunburn alone, and enabled a 20 to 30% reduction in water requirements for irrigation.

In Citrusdal, Jannie Toerien was one of the first citrus producers to make use of shade nets and covered a block of 'Satsuma' mandarins with permanent 20% white shade nets at a height of 3,2 m above the orchard floor. He paid off his nets in the first two years. Shade nets reduced his tree water requirement by 20% and for the last five years his pack-out was consistently higher by 15 to 20%, mainly due to reduction in wind blemishes and sunburn. Under shade nets, his time of harvest is earlier by about two weeks, but control of citrus red mite is his biggest problem.

By: Jakkie (OPJ) Stander and Paul Cronjé, both Citrus Research International based at the Department of Horticultural Science, University of Stellenbosch

THE NEW ZEALAND GREENHOUSE INDUSTRY

New Zealand's greenhouse industry's most significant business includes nursery, flower and salad vegetable production. Tomatoes and capsicums have the largest economic output and have received the most investment in recent times.

This news piece focuses more on greenhouse tomato production because of the industry size, changes and diversity of greenhouses and media used. Tomatoes are grown year-round in structures of different ages and designs with glass and flexible plastic as most common coverings.

The opening of New Zealand's borders to free trade over recent years and the dominance of supermarket retailing have had dramatic effects on tomato grower numbers, their attitude to technology for survival and creating some significant moves to corporate growing. Older and unheated tomato greenhouses are being pulled down for urbanisation or recalibrated for alternative crops like flowers, hydroponic lettuces and fresh salad leaf (mesculin) crops.

Most new structures are Venlo type greenhouses systems partly or completely imported from the Netherlands. Double skin inflated greenhouses (arguably more suited for some parts of New Zealand) gaining a foothold seven to ten years ago have lost to the investment in glass with known world standard systems that give more comfort to corporate growers. Medium size growers have followed suit.

Today very few greenhouses cucumber, capsicum and tomatoes are grown in soil. Bag and bucket growing with sawdust (Pinus radiata) and pumice are the most common methods followed by NFT. The use of stone wool is expanding among the larger growers with one grower installing hanging gutters.

Commercial DFT (deep flow) and aeroponics systems exist but are limited and coconut fibre has just been introduced. Cost and the changing grower profile have diluted local innovation in alternative growing systems but investment in research continues for adapting overseas guidelines for New Zealand conditions to increase production and quality. **By: R. Ivicevich**

AQUACULTURE:
THE IMPORTANCE OF PH MANAGEMENT

Effective water quality management is at the very heart of successful aquaculture, most especially in recirculating aquaculture systems (RAS). We know the story: we feed the fish, they digest the feed and give off ammonia which is toxic and would accumulate in the RAS if not dealt with.

Bacteria in the biofilter convert this poisonous ammonia to benign nitrate, enabling recirculation to continue without the fish health being negatively affected. In this manner the toxic ammonia is managed, but there are many subtle aspects to this equation that are perhaps not as well understood yet are equally important, such as the impact of pH.

When bacteria break down the ammonia and nitrite into nitrate the process gives off hydrogen ions which in turn consume alkalinity (carbonates and bicarbonates in the water). If the availability of free alkalinity in the system is compromised, then the hydrogen ions accumulate, causing the pH to lower and become acidic. pH is simply a measure of hydrogen ions in water; the scale is negative, so a low reading means there are more hydrogen ions present, and it is indicated on a scale of 1-14 where 7 is neutral, less than 7 acidic and greater than 7 basic.

The ideal pH range for freshwater fish farming is 6.5 – 8.0, with 7.5 – 7.8 being the sweet spot for most species. As always, fry are more sensitive than adults of the same species to absolute and fluctuating pH levels.

Few water quality parameters are as poorly understood as pH, causing many people to shy away from measuring and managing it. This is a mistake as the pH directly affects the bacteria in the biofilter as well as the fish themselves.

Low pH has an antibacterial action, consequently, if the system pH is too low the bacteria in the biofilter struggle to convert the ammonia via nitrite to nitrate. If a lower pH is desirable, such as for aquaponics, then this can be overcome by using a larger biofilter to compensate for the slower bacterial activity.

There is a complex equilibrium relationship between carbon dioxide, carbonic acid, carbonates and pH in water, but the essence of this is that a low pH results in the balance swinging towards increased dissolved carbon dioxide levels. This in turn is stressful to the fish as it impairs heart and brain function, so it is important to ensure the pH levels are correct.

The solubility of metals increases as pH decreases, making the metals more toxic to fish at lower concentrations. Similarly, a decrease in pH causes an increase in methaemoglobin which is inefficient at attaching to oxygen molecules, causing the fish to struggle to obtain sufficient oxygen from the water when the pH is depressed.

High pH is less frequently problematic than lower pH, due to the natural fall of pH in a mature RAS. When it does occur, the high pH causes ammonia to become more toxic and the pH directly burns the skin of the fish.

Within reason, fish do adapt to a pH that is stable, even if slightly outside the ideal range, so be cautious when raising the pH to increase the level by no more than a maximum of 0.5 pH units per day. This takes a bit of practice as each system, feed type and buffer are subtly different, but we find that around 100g of buffer is required per kilogram of feed.

Calcitic lime (builder's lime) is very useful as a buffer as it is inexpensive, freely available, soluble and effective, whilst not having negative effects on the fish or downstream environment. Many other buffer options exist, but for fish farming this is our preferred choice.

Given the importance of always maintaining the correct pH, I recommend measuring pH daily and adding buffer every time the pH drops below 7.0. Small amounts of buffer added as frequently as is required will assist in sustaining a healthy RAS for the fish and filter bacteria.

By: Leslie Ter Morshuizen

CALCIUM AND YOUR PLANT – OBTAIN OPTIMAL PRODUCTION

Calcium nutrition is an important component in growing a plant to obtain optimum success. Nutrition by means of NPK is a combination of macro nutrients required to grow any crop.

Most importantly, before planting valuable seed or plants, one must ensure that the pH is correct in a soilless medium or the soil itself. In the soil or medium, a pH of 5.5 to 6.5 offers an acceptable operating value in which a plant would flourish.

Some nutrients cause antagonisms or synonyms; thus said, some nutrients function better along with other nutrients because the higher value in certain nutrient compositions will suppress other nutrients with a lower value. If, for instance the Calcium value is very high in the soil composition, it will suppress the functionality of the magnesium – which is an important nutrient as well.

Similarly, if the ammonium level in the soil or medium is too high, it will also suppress the other nutrients in the combination of the medium.

It is therefore important for the greenhouse operator to keep track of his nutrient combination in his growing medium or his soil.

Nitrogen is present for plant uptake in the ammonium form or the nitrate form (NH4 or NO3) but if ammonia levels are excessive, it suppresses the nitrate functioning.

One needs the solutions offered to plants to be lower in ammonia in order to increase the uptake of calcium.

Nitrates promote the uptake of calcium, magnesium and potassium. On the other hand, when the ammonia levels are higher in plants, it will suppress uptake of valuable food to the plant and inhibit growth. To obtain good, strong cell walls in a plant, calcium is required – it is the cement that bonds cell walls together and in so doing, ensure good quality fruit.

Calcium and nitrogen makes up about half of the fruit. Up to 28% of a healthy fruit contains nitrogen, 6% calcium although the latter plays a major role in the plants' stem cell walls.

The plant with a well-balanced Calcium contents, is much less susceptible to diseases. Calcium-related disorders are often related to environmental conditions such as temperature, humidity, salinity; all conditions that does not favour the uptake of calcium. One may therefore feed the plant enough calcium during the fertilizing program, but its environmental conditions prohibit the uptake of calcium.

Another condition often experienced, is during hot, arid climate where transpiration is so fast, calcium cannot make it to the fruit in time and it appears calcium deficient.

Uptake of calcium is predominantly through the xylem towards the fruit. Therefore it is also important for excellent root establishment to take up calcium via the roots, the xylem to where it matters most; the fruit. In the case of excessive warm conditions the plants, transpiration is high, calcium travel upwards also decreases.

The translocation of calcium is difficult in adverse conditions. The plant requires calcium, which is transported in the nutrient solution from the soil or grow medium, and as explained, it reaches the leaves where it remains.

When the fruit set appears, it takes up the nutrients also containing mobile nitrogen and phosphates from the surrounding leaves to grow bigger to harvesting stage. Nutrient solution values are adjusted by the producer to obtain best results for his ultimate requirements.

Calcium at this stage plays a critical role as it increases in value in the leaf section of the plant. Extra calcium as part of the fertilizing program is given to the plant during fruiting although it is difficult for calcium to travel from the leaf into

the fruit. The problem really lies within management – to ensure the flow of the correct nutrient recipe containing calcium to travel up the plant on a continuous basis and not only when fruit set is observed.

Not following this continuous program, the nutrients remain at the base of the plant and diseases like blossom-end rot (clearly visible in peppers and tomatoes) and the lack of nutrients and calcium id even visible at the end of plant stem or leaves.

Especially in peppers, if the leaves around fruit set are wilted and yellowing, it is better to pick the fruit and discard it. In strawberries the stem goes dark and leaves wilt and fruit turns black – a sure sign of deficiency of nutrients.

Even in celery, cabbage and fruit, lack of readily available calcium in the nutrients are too obvious, but too late to adjust to save the crop.

How to overcome these situations to take preventative or at least corrective action? Since summertime comes with high temperatures, irrigation must be stepped up and nitrogen content of nutrition increased.

Good-looking peppers because of aptly calcium applied.

Quality produce on a plant with well-balanced nutrients.

The management of any fresh produce or fruit production lies therein that records must be held of date, prevailing outside temperature, pH levels taken at different areas in the greenhouses, nutrition dosing recipes applied and quantity of fruit obtained per plant.

Also, in case of adverse situations, what the causes were, remedial steps taken and dates thereof. In this way the producer builds up a personal history record on which he can reflect in times of crises but that his staff or eventual manager can use as a handy tool to ensure flow of production at even keel.

Separate tanks for nutrients

In a typical greenhouse with automated dosing system one would find an A tank, holding nutrients (micro-nutrients; sulphur and phosphate for a hydroponics mix) without calcium, then the B tank holding Calcium and magnesium nitrate.

A new product used in Spain and the Netherlands is now launched in South Africa (enquire at your agro chemicals outlet). It is a more refined nitrogen calcium product that can be used in difficult conditions of calcium uptake.

The calcium and nitrogen levels are increased and more concentrated although, the calcium is significantly higher concentrated than the nitrogen which offers the producer more management options.

Ammonia level in the product is dropped from 1.3% to .3% to ensure enough calcium is released.

It is important that the pH does not acidify more; therefore the new product will rectify this. In zones with ultra-hot temperature and high radiation, the plant takes up a lot of water and a solution with low ammonia is required.

Once excessive ammonia is taken up by the plant, the amino acids in the leaves are required to neutralize the effect of the ammonia, but can only do so if the flow of water up the xylem is fast enough. The product is also more concentrated which means easier to handle and takes less storage space.

It is often observed that farmers have too much nitrogen in the system which appears as leaf yellowing. These plants are very lush but are more susceptible to plant diseases, but the right product can correct this for the producer.

By: James Grundlingh, Researcher

Despite the outstanding positive impact of a booming greenhouse industry in the Spanish economy, this "success story" has had an undesirable effect on the local environment. Local water resources have been adversely affected by irrigated greenhouse horticulture – there has been overexploitation, nitrate contamination and salinization of aquifers.

HOW TO MANAGE LEECHING FROM A GREENHOUSE

To reverse this trend, various technologies and management practices have been implemented and much research is being done to find sustainable solutions.

One example in particular highlight the efforts to adopt environment-friendly production techniques. Integrated pest management (IPM) was widely implemented in cultivating the main crops. IPM minimizes the use of chemicals and relies on natural enemies and beneficial organisms for crops.

Almería has become the world's leading area in using this system, ahead of countries such as The Netherlands and Israel. The implementation of IPM has led to a strong decline in the use of phytosanitary products and a partial removal of chemical residues.

Another sustainable solution is the use of fertigation systems. Fertigation refers to the application of fertilizers through the irrigation water by connecting a fertilizer injector directly to the irrigation system. This allows the supply of correct levels of nutrients exactly and uniformly, and only to the wetted root volume where the active roots are concentrated.

This significantly increases fertilizer-use efficiency, which means that the applied fertilizer rate can be reduced. This reduces production costs, and groundwater pollution caused by the leaching of fertilizer/ accumulation of nutrients and salts in the topsoil.

Much research has been (and is still being) done to optimize resource use and decrease the impact on the environment. For instance, the WATERGY project - funded within the European Union's 5thFramework Programme – developed the 'closed greenhouse' concept that involves implementing a new method of passive climate control and water treatment (desalinization and irrigation water recycling) by only using solar energy.

Air in a closed greenhouse is humidified by plants. It rises into the roof area, where it is further humidified by evaporation devices. The air rises by buoyancy, reaching the upper end of a cooling duct, where it cools down and the water vapour condenses as it reaches dew point. The cooled air becomes heavier and falls back through the duct into the vegetation area at the ground level.

The concept aims to help change from an extremely water-and-nutrients-demanding system to a water producing and nutrients recycling horticultural one. Further help towards achieving this objective is by using a closed-loop greenhouse irrigation and fertilization system, using wastewater and saline water as an input.

A closed greenhouse ideally does not need any water input as it is cycling within the closed internal atmosphere. There will always be some losses, but significant water efficiency has already been achieved (at 0,5 litres/m2 below daily water demand) in intensive cultivation.

Source: Greenhouse Innovations

Air circulation in a closed greenhouse

GETTING RID OF FUSARIUM

Healthy Lisianthus

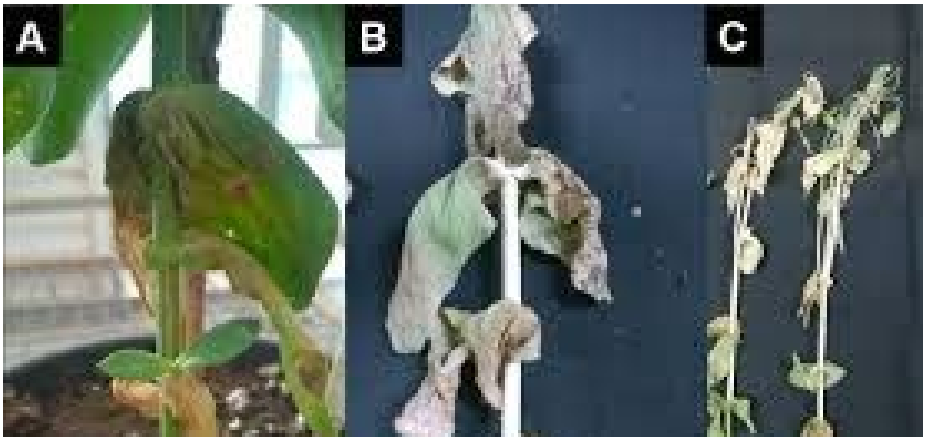
Fusarium causes a lot of greenhouse growers headaches. The fungus ensures that crops such as lettuce, tomato or phalaenopsis become ill or even die. Fusarium can be controlled with plant protection products, but the number of authorized products is shrinking.

Fusarium is a pathogenic fungus and can cause damage both above and below ground. Fusarium rot affects roots of plants: vascular bundles get clogged by fungal growth and can no longer transport water and food. The result: the crop withers or even dies. Especially in the cultivation of lettuce this caused many problems in recent years. Contaminated soil or substrate must therefore be properly disinfected.

Two solutions have often been applied to a Fusarium infection: removing diseased plants or using chemicals. The latter solution is becoming increasingly difficult: due to stricter legislation fewer chemicals are permitted, Fusarium is becoming more resistant to some drugs and there are many different variants of the fungus. In addition, the use of chemical agents in the vegetable industry encounters objections in society.

It is therefor high time for proper alternatives. That is also the opinion of growers of lisianthus and phalaenopsis. The University of Wageningen has started with research trials on Lisianthus and phalaenopsis.

Three routes are being examined. First of all the use of biological crop protection products to combat Fusarium. For this, use is made of resources that are already commercially available.



The second route is to encourage the plant to defend itself better against the fungus by using so-called elicitors of induced resistance. And the third route focuses on soil resilience: can the soil be manipulated in such a way, for example by adding organic substances, that there is less chance of infection with Fusarium?

This information will hopefully set the minds of the above-mentioned flower types producers thinking about their greenhouse disciplines to combat Fusarium! **The research was done by Dr MA Streminska.**







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