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PRODUCTION GUIDELINES / SOUTH AFRICA

# Protected Production



**CHOOSE THE SYSTEM. MEASURE. MAINTAIN. REVIEW.**

A practical planning and operating guide for vegetable production under net structures, tunnels and greenhouses, including soil and hydroponic systems.


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PLAN THE ENTERPRISE

# Design around the crop and buyer

Protection can modify the crop environment, but it does not remove the need for suitable genetics, reliable inputs, skilled work and a market.

| Decision / crop | Practical guidance |
|---|---|
| Product and season | Specify crop, grade, harvest months, weekly volume and customer. Test demand and prices before sizing the structure. |
| Local climate | Use site temperature, wind, solar exposure, humidity, frost and storm history. Assess what the proposed structure can actually control. |
| Water | Confirm usable supply through the peak season and test its quality before construction. Water availability and water suitability are different questions. [6] |
| Services and access | Plan power, backup supply, drainage, deliveries, worker facilities, chemical storage and a clean packing route. |
| Management capacity | Budget daily monitoring and response, crop work, maintenance and recordkeeping. Automation still needs a responsible operator. |

## Compare whole-system costs

Include earthworks, drainage, structure, covering replacement, irrigation, growing medium, cooling, labour and downtime. Compare costs per accepted kilogram and per crop cycle; a low structure price is not necessarily a low production cost.

## Use a staged trial

Start with a manageable area and predefined measures of success: accepted yield, grade, water use, labour and rejection. Expand after the crop, system and market have performed together under local conditions.

**Project brief:** crop / buyer / season / usable water / power / site risks / responsible operator / capital and operating budget / trial success measures.

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STRUCTURE & SITE

# Specify the protection you need

Net houses, tunnels and controlled greenhouses offer different levels of protection. Choose for the crop and site rather than assuming one design is best everywhere.

| Decision / crop | Practical guidance |
|---|---|
| Shade-net structure | Can moderate radiation and some weather exposure. Rain exclusion and temperature control depend on the actual design and cover. |
| Plastic tunnel | Provides a covered growing space; ventilation, condensation and storm resistance need explicit design attention. |
| Controlled greenhouse | Heating, cooling, screens and controls can widen operating capability, with higher service and maintenance demands. |
| Covering and screen | Compare light transmission, durability, condensation behaviour, pest exclusion and repair cost. A finer insect screen can restrict airflow. |
| Site layout | Provide drainage and access without shading productive areas. Keep runoff from entering the growing zone and allow maintenance access. [1] |

## Have the structure assessed

Obtain a site-specific design for wind, roof and crop-support loads, anchoring and local requirements. Crop wires should not be attached to a frame that has not been designed for that load.

## Commission before planting

Check vents, doors, fans, drainage and controller response. Record the supplier’s operating limits and storm procedure. Train the operator and keep spare critical parts accessible.

**Handover checks:** design and drawings / cover specification / load limits / ventilation test / drainage test / manuals / maintenance schedule / emergency contacts.

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CLIMATE MANAGEMENT

# Measure where the crop grows

Use representative sensors at crop height, protected from direct radiation where appropriate. Keep records of conditions and of the actions taken.

| Decision / crop | Practical guidance |
|---|---|
| Temperature | Record daily extremes and their duration. A daily average can hide damaging hot or cold periods. |
| Light | Record shading and, where available, measured crop-level light. Use appropriate units; do not compare an instantaneous reading with a daily light total. |
| Humidity and dew | RH changes with temperature. Inspect condensation and leaf wetness as well as the displayed percentage. Dense canopies can trap moisture. [3] |
| Air circulation | Circulation reduces local still-air pockets but is not a substitute for exchanging humid air with outside air. |
| Ventilation | Vent area, wind, screen resistance and inlet/outlet placement affect air exchange. Natural ventilation performance is site-dependent. [2] |

## Coordinate control actions

Agree crop-stage settings and response priorities with the crop adviser. Shading, ventilation, irrigation and heating interact; record changes so their effect can be assessed. Ventilation alone cannot guarantee an indoor temperature below outside air.

## Match equipment to conditions

Evaporative cooling depends on outside humidity and needs suitable water and maintenance. Heating requires safe installation and exhaust arrangements. Use specialist design for carbon-dioxide enrichment, including monitoring and worker protection; it is not a default upgrade.

**Daily climate log:** crop position / temperature and humidity / condensation / shade and vent status / alarms / action / observed crop response.

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GROWING SYSTEMS

# Choose the root environment

Soil culture and hydroponics require different monitoring. Hydroponics includes nutrient-solution culture and production in soilless media. [4]

| Decision / crop | Practical guidance |
|---|---|
| Soil beds | Assess drainage, compaction, soil fertility and pathogen history. Manage salts and root-zone moisture using soil-appropriate measurements. |
| Drip into substrate | Pots, bags or slabs provide support and a water reserve that depends on the medium. Match delivery and drainage to container size and root demand. |
| Nutrient film technique | Roots receive a flowing nutrient film in channels. Keep flow paths clear and have a rapid response to supply failure. |
| Deep-water / raft | Roots grow in a nutrient solution reservoir. Monitor solution condition and provide the oxygen-management system the design requires. |
| Flood-and-drain | Containers are wetted by a controlled flooding cycle. Verify uniform filling, complete drainage and the hygiene of shared return water. |

## Specify the medium, not only its name

Compare air and water retention, initial salts, pH, uniformity, stability and disposal options. Request a specification and test a representative batch. Coir, bark, perlite and other materials are not interchangeable solely by volume.

## Plan interruptions and changeovers

Record how long the crop can tolerate a pump or power failure under hot conditions. Test backup arrangements. Agree how roots, medium and irrigation components will be cleaned, replaced or safely disposed of at crop end.

**System decision:** crop / medium or solution / container or channel / delivery / oxygen and drainage / return-water route / failure response / operator.

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WATER QUALITY

# Test the supply before the recipe

Collect samples using the laboratory's instructions and identify the source and date. Re-test when the source or seasonal conditions change.

| Decision / crop | Practical guidance |
|---|---|
| pH | Describes acidity at the time of measurement. A high pH alone does not establish the amount of acid needed. |
| Alkalinity | Describes acid-neutralising capacity and affects growing-medium pH over time. Measure it separately from pH. [5] |
| Electrical conductivity | Indicates total dissolved-salt conductivity. It cannot show which individual ions are excessive or deficient. |
| Ion analysis | Review sodium, chloride, bicarbonate, calcium, magnesium and relevant nutrients with an adviser. Account for source-water contributions. |
| Microbiological quality | Assess risk for the intended use: irrigation, recirculation and produce washing are different uses with different controls. |

## Use a source-specific plan

UMass recommends testing potential irrigation water before construction and monitoring established supplies through the year. Increase checks when quality varies or a new source is introduced. [6]

## Define corrective treatment carefully

Have acidification, desalination, blending or filtration designed for the measured problem. Specify the endpoint and verify treated water. Handling and injection equipment must suit the chemicals and materials used; no generic acid dose is provided here.

**Water record:** source / sample method / laboratory report / seasonal variation / treatment purpose / endpoint / verification / nutrient contribution.

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IRRIGATION & NUTRIENTS

# Verify delivery at the plant

A controller setting is not proof of water delivery. Compare actual output at representative outlets, including the far ends of lines.

| Decision / crop | Practical guidance |
|---|---|
| Uniformity | Collect timed outlet samples and compare volumes. Investigate blocked emitters, pressure differences and leaks before changing the whole zone. |
| Scheduling | Adjust dose and frequency for crop demand, light, root volume and medium. Check root-zone moisture and drainage, not elapsed time alone. [7] |
| Feed specification | Write the intended nutrient concentrations and water contribution. Check product analyses, injector ratio and stock-tank volume before mixing. |
| Sampling | Keep source, applied feed, reservoir and drainage readings distinct. Use consistent timing and a defined root-zone extraction method. |
| Recirculation | A returned solution changes as plants remove ions and water. EC and pH alone cannot prove a balanced nutrient composition. [4] |

## Keep calculations explicit

Example: an outlet delivering 2 L/hour for 3 minutes applies 0.10 L. Ten such events apply 1 L at that outlet. Measure the actual flow and set the event programme for the crop; this example is not a daily requirement.

## Review solution condition

Calibrate meters and inspect roots alongside readings. Set replenishment, analysis and replacement from the system plan and evidence. Do not change every reservoir on a fixed calendar without checking crop and water conditions.

**Daily irrigation check:** tank level / pump and filters / outlet flow / delivered volume / EC and pH / root-zone condition / drainage / alarms.

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HYGIENE & WATER TREATMENT

# Match the method to the job

Physical cleaning, surface disinfection, irrigation-water treatment and produce sanitation are different operations. Write a separate procedure for each.

## Clean before disinfecting

Remove plant debris, soil and algae before using a suitable disinfectant. Organic residues can shield pathogens and reduce effectiveness. Record the permitted surface, concentration, contact time and rinsing requirement from the current label. [9]

| Decision / crop | Practical guidance |
|---|---|
| Filtration | Select for suspended solids and the irrigation equipment. Clear-looking water is not proof that pathogens or dissolved salts have been removed. |
| UV treatment | Performance depends on water clarity, flow, delivered dose and maintenance. Verify that the installed system is appropriate for the target and peak flow. |
| Chemical treatment | Use only an approved, compatible programme designed for the actual water and use. Monitor the required treatment endpoint and crop exposure. |
| Heat / other systems | Compare validated treatment performance, energy demand and maintenance. Obtain design support before recirculating treated water. |
| Recontamination | Keep clean and dirty tanks, hoses and tools separated. Check that treated water cannot be contaminated again before it reaches the crop. |

## Verify the result

Water treatment may reduce pathogen risk, but a running lamp or dosing pump is not a performance test. Use the supplier's validation and a suitable sampling plan, and record failures and corrective actions. [8]

**Procedure record:** purpose / target / permitted use / equipment / operating limit / endpoint / test result / person responsible / corrective action.

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CROP HEALTH & BIOSECURITY

# Make scouting a routine

Protection changes pest and disease pressure; it does not make the crop pest-free. Prevention, inspection and rapid diagnosis work together.

| Decision / crop | Practical guidance |
|---|---|
| Incoming plants | Check nursery identity, seedling condition and records. Keep suspect lots separate and map where each lot is planted. |
| Entry and movement | Define visitor, worker and tool routes. Attend healthy areas first and manage movement from suspect zones. |
| Monitoring | Inspect plants and use traps where appropriate. Record pests, beneficial organisms and symptoms by location; traps supplement plant inspection. |
| Roots and water | Inspect root colour and condition and compare symptoms across irrigation zones. A shared return system can link apparently separate crop areas. |
| Crop end | Remove residues promptly, clean accessible structures and equipment, repair screens and address recurring wet areas before replanting. [9] |

## Use diagnosis to choose controls

Identify the pest or pathogen and review environmental causes. Select resistant material and biological or other controls appropriate to the crop and local system. Keep compatibility with beneficial organisms and harvest timing in the plan.

## Check the exact permitted use

Confirm the current South African registration and label for the crop, target and protected situation. Follow rates, worker re-entry and preharvest intervals, and keep application records. Surface products and crop-protection products are not interchangeable. [10]

**Scouting record:** date / house and row / crop stage / symptoms and live pests / sample / decision / interval restrictions / follow-up result.

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OPERATION & PERFORMANCE

# Run the system as a daily routine

Assign responsibility for normal operation, alarm response and weekend cover. Keep a concise log that another trained person can use.

| Decision / crop | Practical guidance |
|---|---|
| Every day | Check crop condition, climate readings, water supply, pump operation, feed delivery, drainage and alarms. Record exceptions and actions. |
| Scheduled service | Inspect filters, emitters, fans, vents, screens, supports and sensors. Follow equipment-specific service intervals and record completed work. |
| Power or pump failure | Identify the affected zones, deploy the tested backup and verify recovery at the plants. Record duration and inspect the crop afterward. |
| Storm or heat event | Follow the structure supplier’s procedure and the crop response plan. Verify readings and equipment rather than relying only on an app notification. |
| Harvest and packing | Use the crop-specific maturity, hygiene and cooling guide. Keep harvest identity linked to crop inputs and the buyer’s delivery record. |

## Measure accepted production

Track accepted kilograms per square metre per crop, grade mix, rejection, litres per accepted kilogram, labour hours and energy use. State the area and time basis. Compare similar seasons and production systems.

## Close the cycle with a decision

Review root causes of losses and maintenance failures before ordering the next crop. Prioritise changes that address recorded problems, and trial major alterations before applying them to the whole operation.

**Weekly review:** accepted yield / grade and rejects / water and energy / labour / crop-health events / equipment failures / corrective action / owner and due date.

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FILLABLE CROP PLANNER

# Your next planting

Save a copy before filling it in. Use a PDF reader that supports forms and keep the completed record with your field documents.

**Farm / site / structure and system**

**Crop / cultivar / nursery or seed lot**

**Planting / harvest / crop-change dates**

**Area / root medium / irrigation zones**

**Buyer / grade / weekly volume / cooling**

**Water report / nutrient plan / treatment**

**Next action / responsible person / due date**

## Ready-to-plant checks

- [ ] Buyer and crop plan agreed
- [ ] Structure and services checked
- [ ] Water quality reviewed
- [ ] Irrigation and backup tested
- [ ] Hygiene and scouting ready
- [ ] Operator and records assigned

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REFERENCES & EDITION NOTES

# Sources you can follow

Independent sources reviewed on 18 September 2026. Links are clickable. Older sources support established principles; overseas dates and product approvals are not transferred to South Africa.


**01. UF/IFAS - Physical Greenhouse Design**
Structure, covering and design considerations; adapt to the site.

**02. UMass - Natural Ventilation in Greenhouses (2026)**
Vent arrangement, wind, shading and air exchange.

**03. UMass - Reducing Greenhouse Humidity**
Canopy moisture, circulation and ventilation principles.

**04. Penn State - Hydroponic Systems and Plant Nutrition (2026)**
Water culture, substrates and nutrient management.

**05. UMass - Water Quality: pH and Alkalinity**
Why source-water pH and alkalinity must be distinguished.

**06. UMass - Water Analysis**
Source testing before construction and monitoring through the year.

**07. UF/IFAS - Irrigation of Greenhouse Vegetables**
Delivery, substrate moisture and irrigation-system design.

**08. UMass - Greenhouse Irrigation Systems**
Irrigation, recirculation and treatment principles.

**09. UMass - Cleaning and Disinfecting the Greenhouse**
Remove debris before disinfection; overseas product labels are not local approvals.

**10. South African Government - Agricultural remedies**
Registration framework; verify the current approved crop and use on the label.



**About this edition.** Original AgriCart editorial synthesis for planning and education. Obtain farm-specific advice before setting inputs and crop-protection programmes. No yield or shelf-life guarantee is implied. Cover image is AI-generated illustration, not a documented farm or named cultivar. Source organisations do not endorse AgriCart.