Berries in Controlled Environment Agriculture

Greenhouse Engineering Design & Crop Production Short Course

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Hort Americas Technical Service

OUTLINE

- **Hydroponic systems**
- **Rootzone environment control**
- **Irrigation and nutrition**
- **Environmental control in greenhouse:**

a) Temperature

b) Light/ Photoperiod/ LEDs light in vertical farms

c) Relative Humidity

- **Crop management**
- **Yield expectations**

Hydroponic systems

HYDROPONIC STRAWBERRY IN CEA

Hydroponic Systems

TABLE-TOP

Hydroponic Systems

HANGING GUTTER SYSTEM

Hydroponic Systems

TABLE-TOP

Gutter supported by a “table”

Common system in Europe and North America

Plants are grown in plastic trough or bags filled with substrate

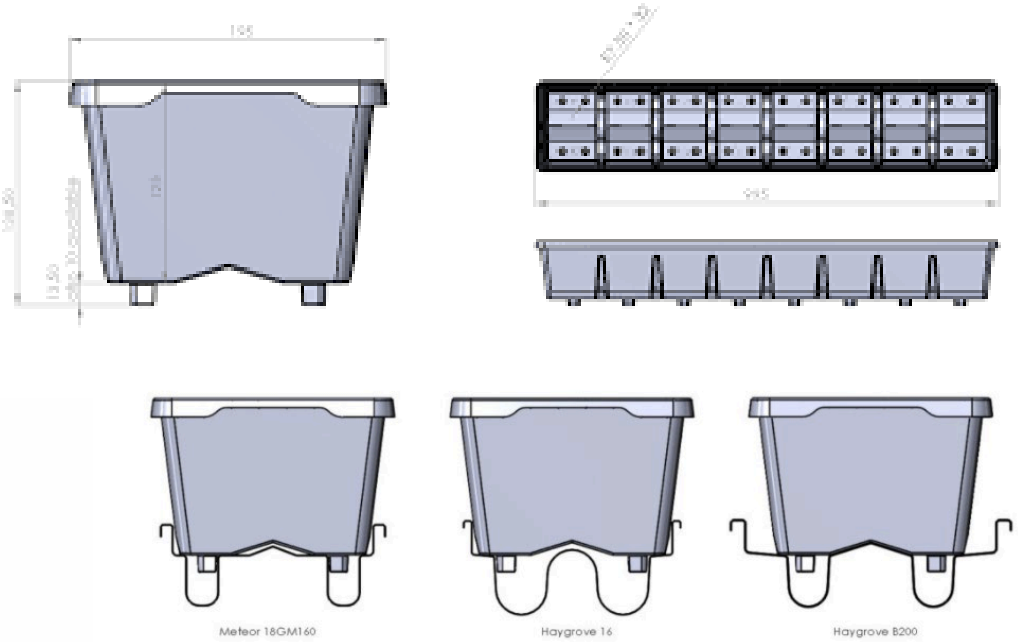
- Drip Irrigation
- Open system

Strawberry Troughs

- Drip irrigation
- Open system

Berry Troughs → up to 18 L

- **Optimal drainage**
- **Spacious 18 liter capacity enables good strawberry plant management**
- **Suitable for table top systems**

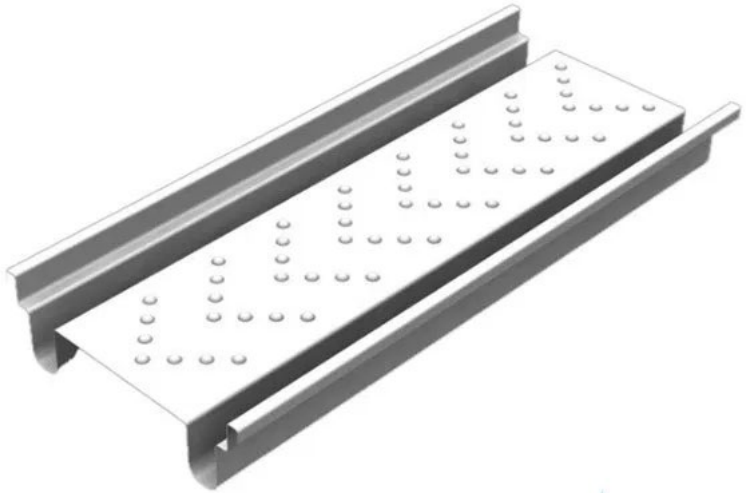


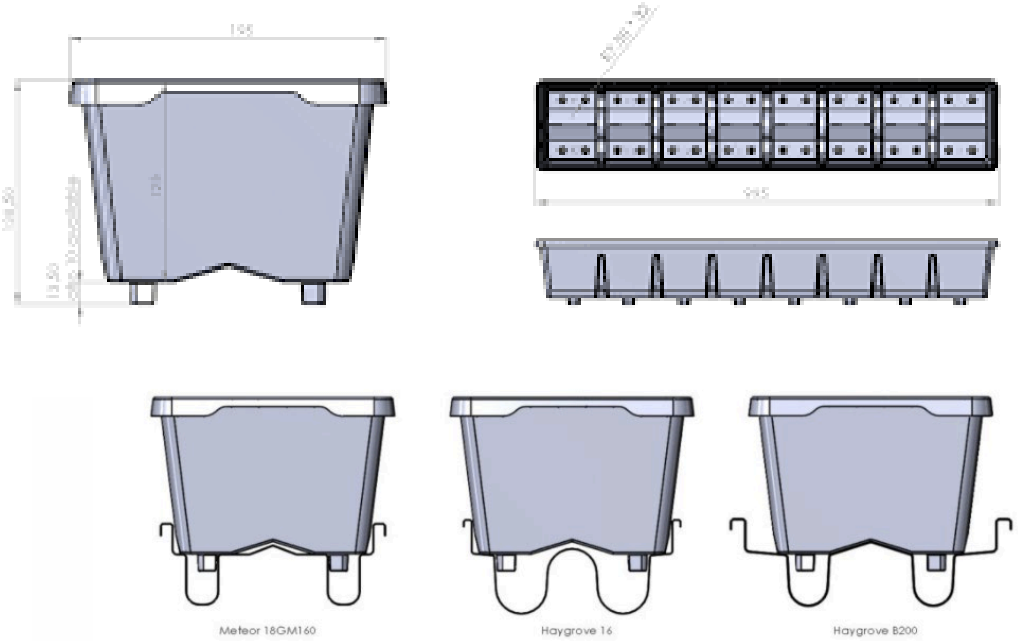
Suitable for various types of gutter:

Meteor GM 18- 160
Haygrove 16
Haygrove B200

Substrate volume per plant: 2 L or more is recommended

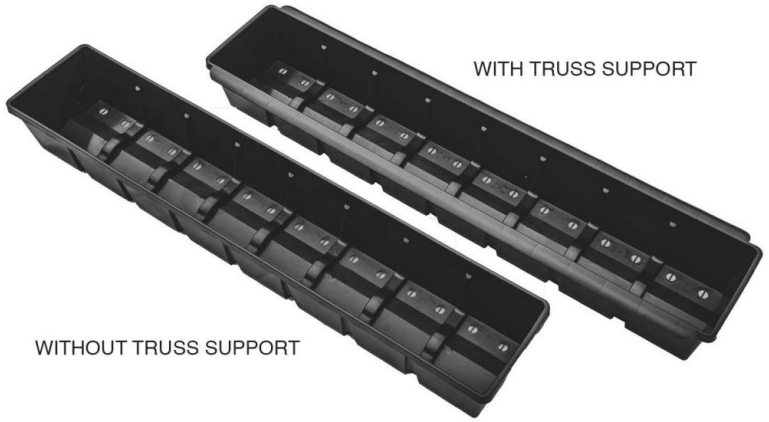
Berry Troughs → up to 18 L





Berry Troughs → up to 18 L

Irrigation equipment: NETAFIM / METEOR SYSTEMS



Berry Troughs

Substrate volume per plant: 2 L or more is recommended

Rootzone environmental conditions

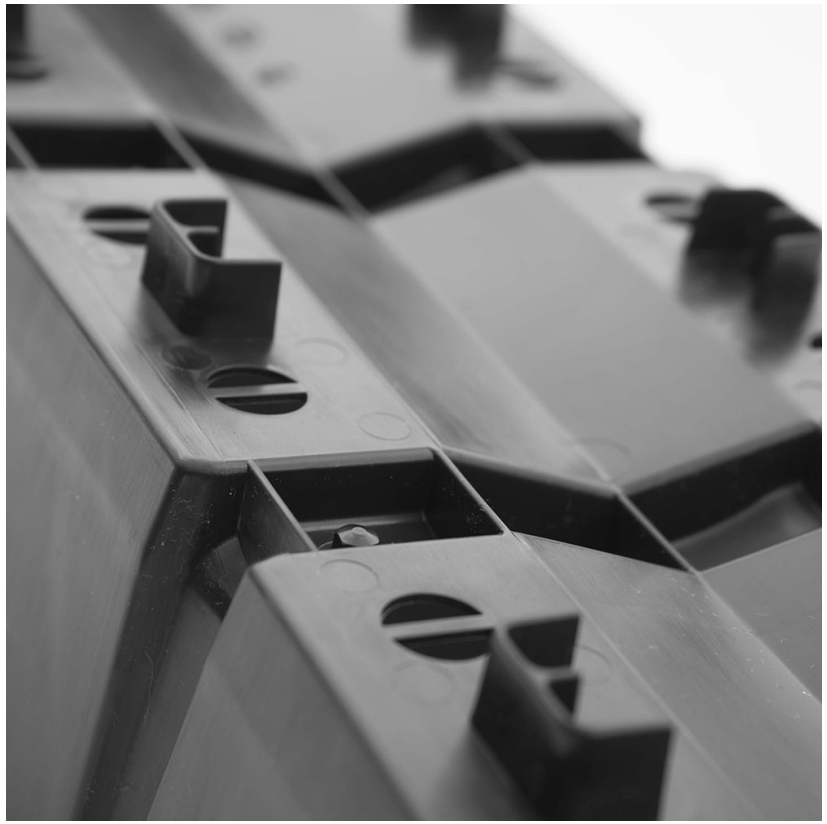
SUBSTRATE VOLUME

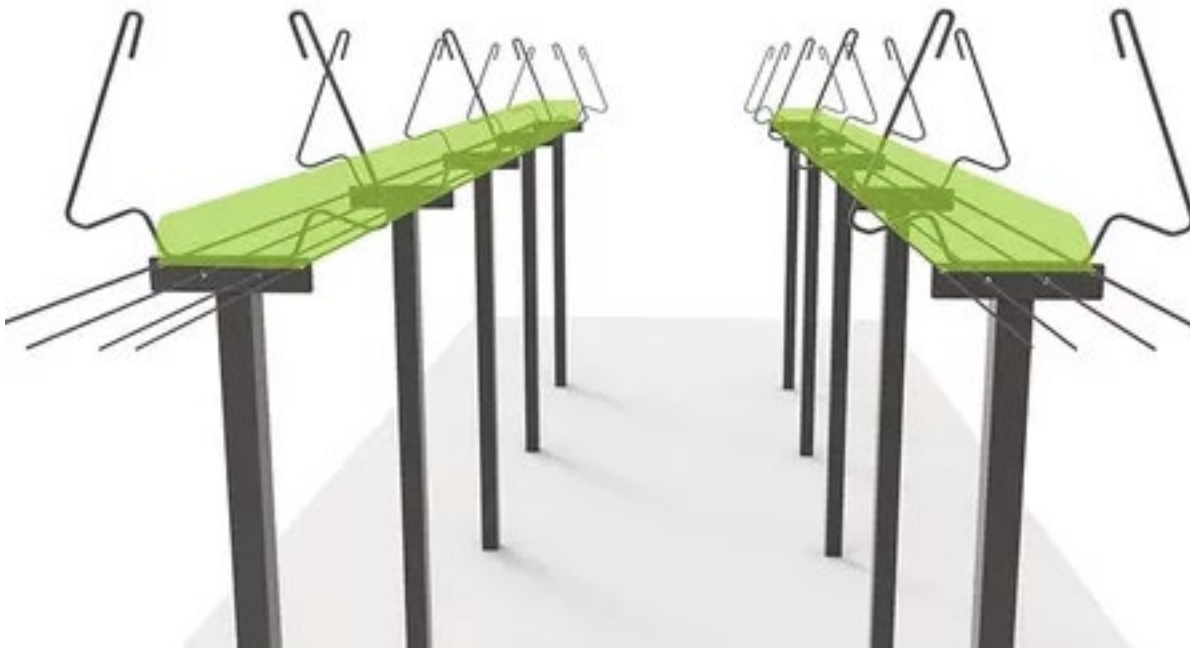
Minimum of 2 liters per plant

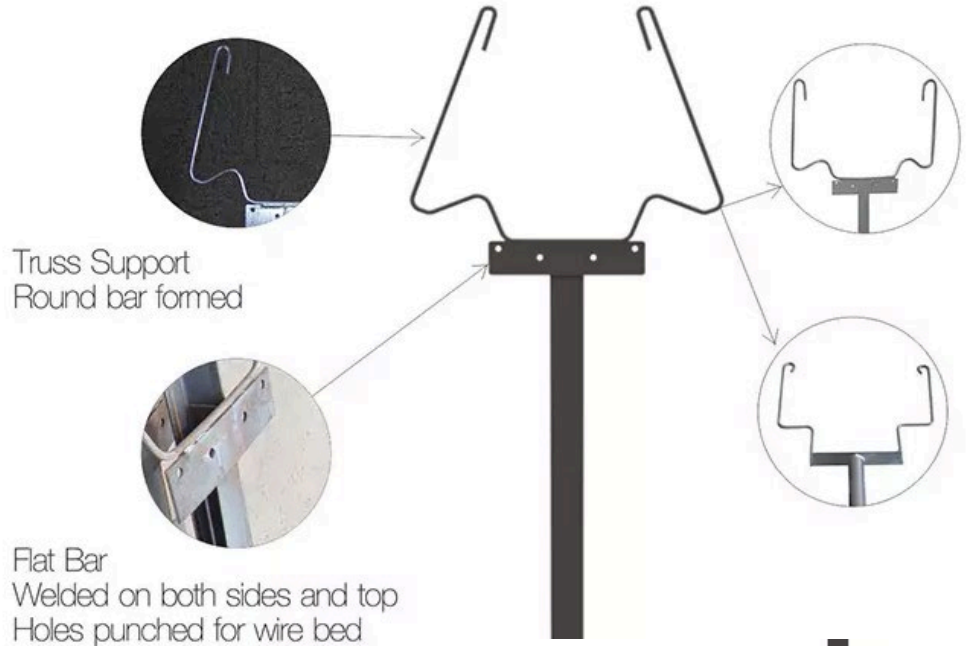
Taller containers work better than short ones→ Better drainage and aeration

Kubota Lab, The Ohio State University

Berry Troughs → up to 18 L

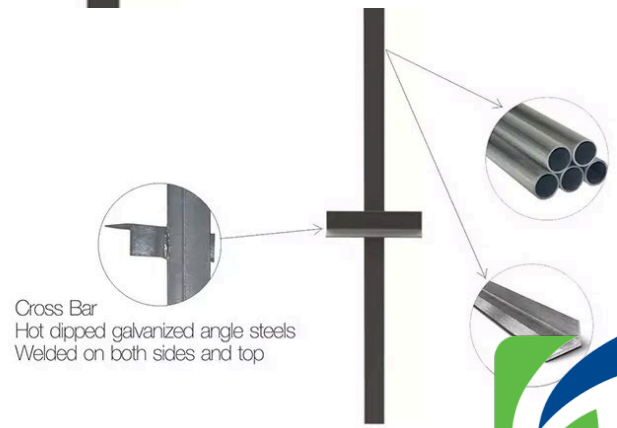






Truss Support
Round bar formed

Flat Bar
Welded on both sides and top
Holes punched for wire bed
Hot dipped galvanizing finished



Cross Bar
Hot dipped galvanized angle steels
Welded on both sides and top

Hydroponic Systems

HANGING GUTTER SYSTEM

Steel hanging gutters

A typical spacing between gutters is 0.8 – 1.0 meters (center-to-center).

Containers and bags filled with substrates are placed in hanging gutters

- Drip irrigation
- Open system

Hydroponic Systems

METEOR design a special suspension for every crop that best suits your situation.

They extensively test the system to check that it can carry the weight of the fully loaded growing gutter.

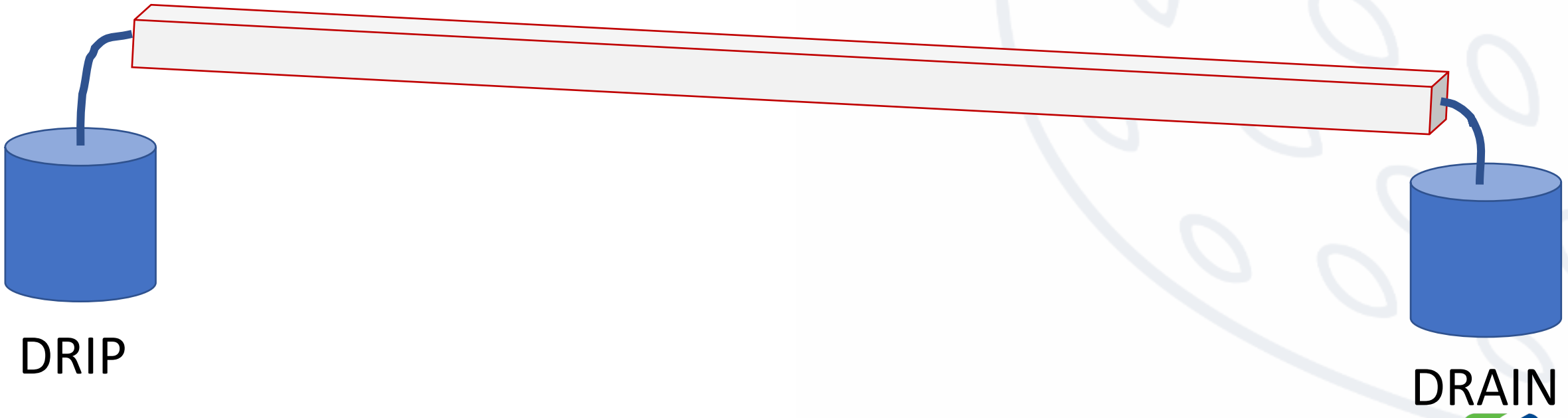
Suspended systems for growing gutters are supplied in custom lengths.

A suspension generally consists of a fastening to attach it to the trellis or tunnel tube, a steel cable, a grow tube hook and a suspension bracket.

HANGING GUTTER SYSTEM

METEOR SYSTEM

Commercial Hydroponic System for strawberries



Hydroponic towers

NFT Systems

NFT Systems

NFT is a risky system with little buffering capacity

NFT for strawberry employs a wide channel to assure the nutrient circulation through the large mass of roots.

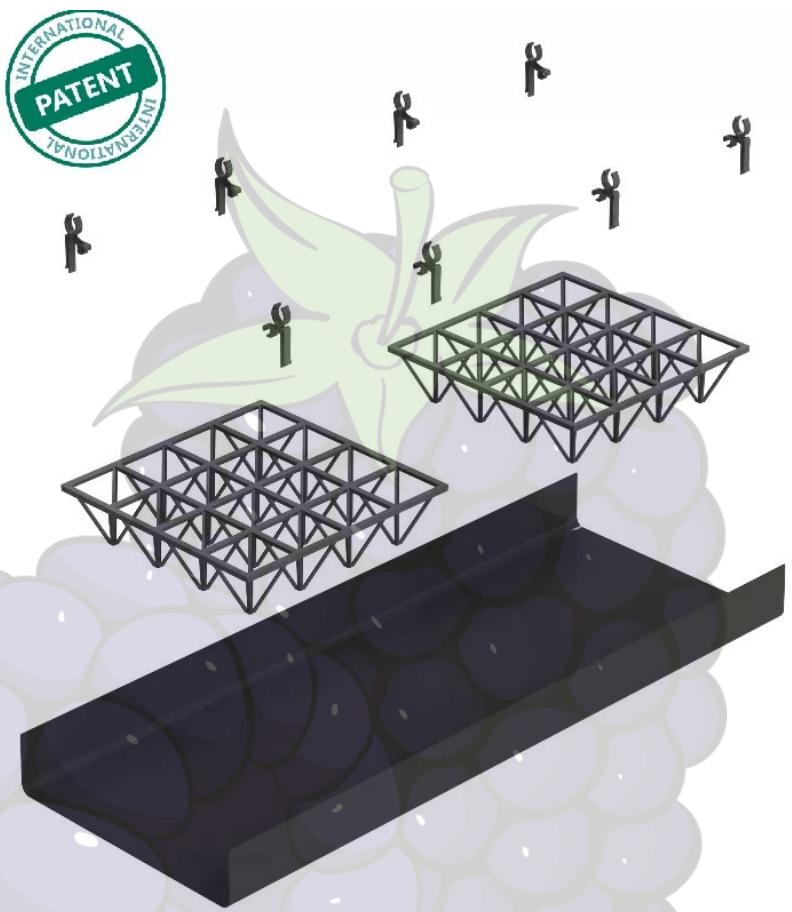
HYDROPONIC SYSTEMS IN BLUEBERRIES and BLACKBERRIES

- **Substrate based**
- **Pots/ bags**
- **Drip irrigation**
- **Open system**

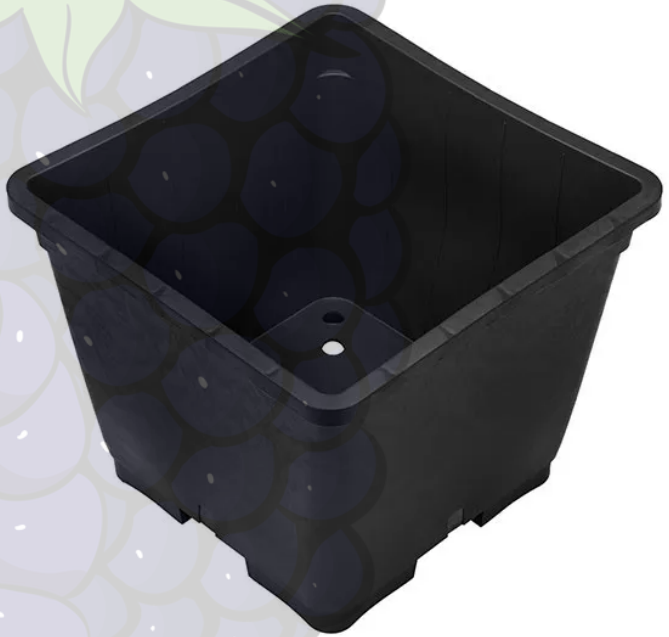
Hydroponic System in Blueberries And Blackberries

- **Substrate – Bag / Pot**
- **Drip irrigation**
- **Drainage channel**

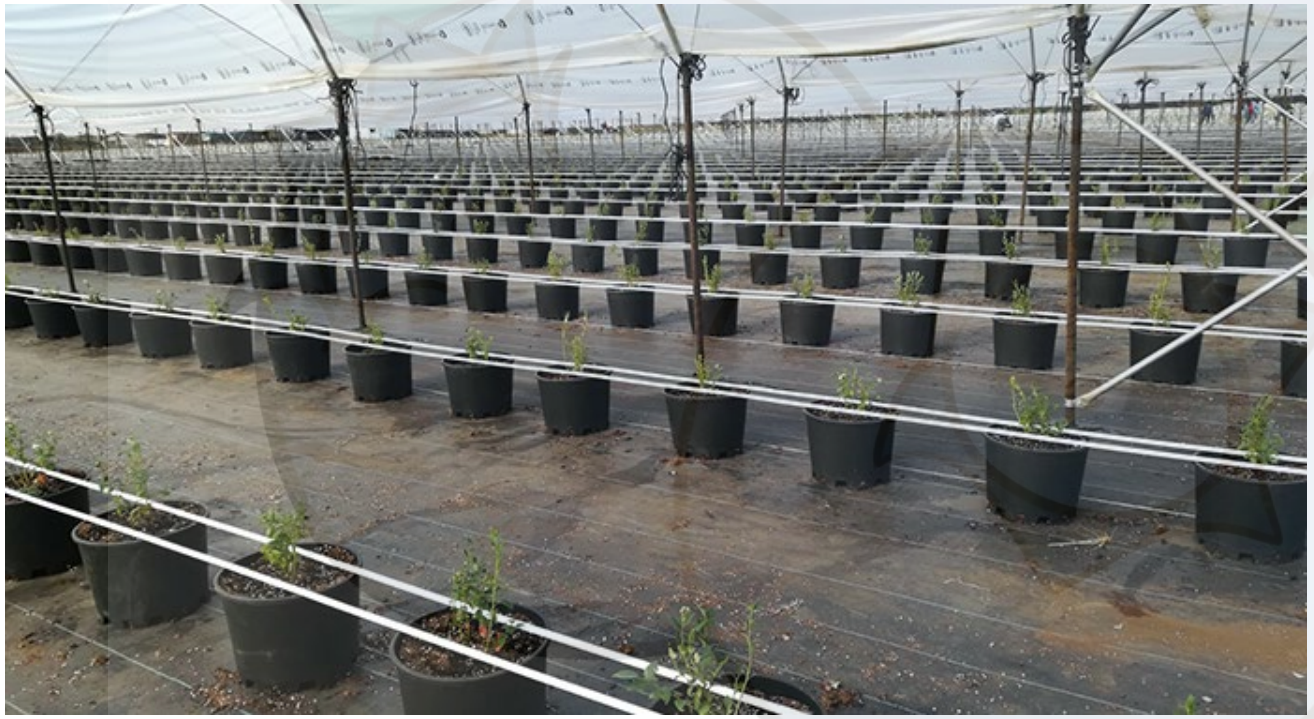
Hydroponic System in Blueberries and Blackberries



Pots – Drip irrigation



From 25 to 45 L



SUBSTRATES

Substrates

Important aspects:

✓ Porosity

Strawberry requires high porosity levels

~15% air porosity – Strawberries
~15-25% air porosity – Blueberries/ Blackberries

~50-60% water holding capacity

Substrates

MIX:

50 % Perlite

25% Coconut coir

25% Peatmoss

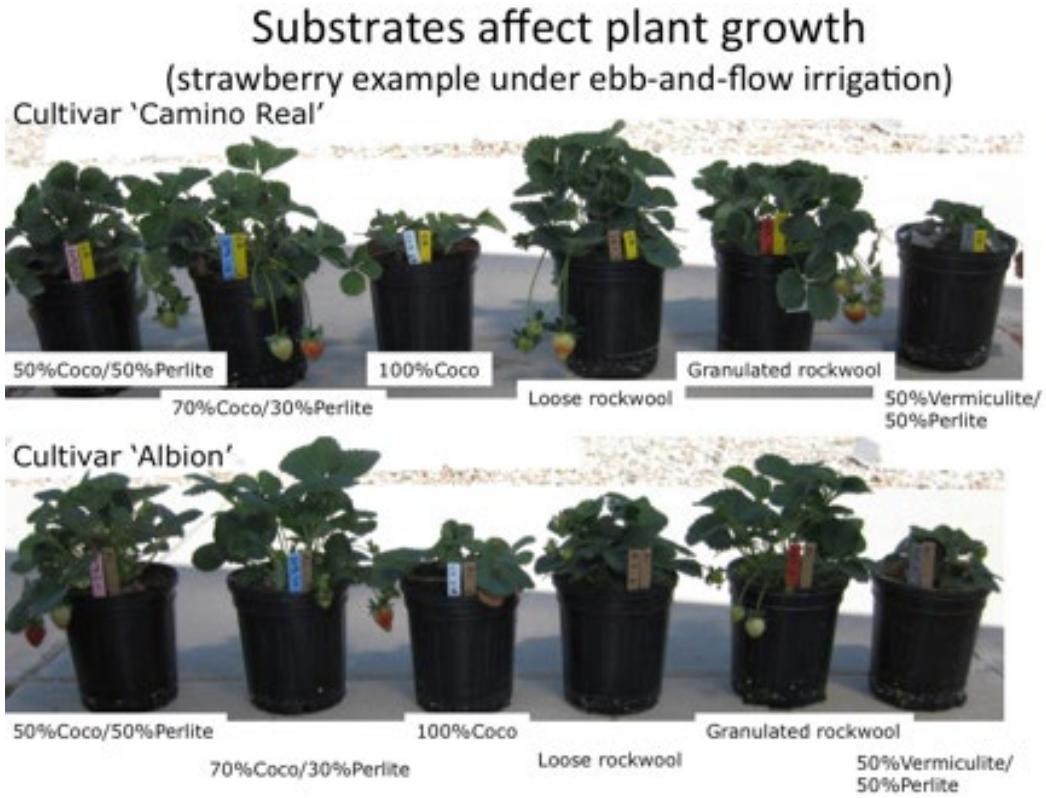
SUBSTRATES - Strawberries

Rootzone environmental conditions

pH: 5.5 to 6

EC level: 1 dS/m or less

Porosity



Strawberry plants are very sensitive to root zone environment

SUBSTRATES – Blueberries/Blackberries

MEDIUM MIX

70% coco peat, 30% short coco fiber

WATER RETENTION	●●●●
AIR RETENTION	●●●●
WATERING FRECUENCY	●●●●
DRAINAGE	●●●●
VOLUME	●●●●
LIFE SPAN	●●●●

THICK MIX

40% coco peat, 30% long fiber, 30% chips

WATER RETENTION	●●●
AIR RETENTION	●●●●●
WATERING FRECUENCY	●●●●●
DRAINAGE	●●●●●
VOLUME	●●●
LIFE SPAN	●●●●●

NUTRIENT REQUIREMENT AND IRRIGATION

NUTRIENT REQUIREMENT

Element	mg/L
NO3-N	70
NH4-N	7
PO4-P	21.4
K	117.3
Ca	55-85
Mg	12.2
SO4-S	16.1
Cl	45.1

← Used to avoid increase in pH

FRUIT PRODUCTION

Yamasaki Formula, Kubota Lab, The Ohio State University

NUTRIENT REQUIREMENT

Element	mg/L
NO3-N	80
NH4-N	20
PO4-P	21.4
K	145.2
Ca	55-85
Mg	12.2
SO4-S	39
Cl	45.1

RUNNER PRODUCTION

Yamasaki Formula, Kubota Lab, The Ohio State University

NUTRIENT REQUIREMENT

a) RUNNER PRODUCTION

b) FRUIT PRODUCTION

Nutrient requirement - Blueberry

Fuente: Fonseca, 2016.

Macronutrients (ppm)							
NH_4^+	NO_3^-	$PO_4^=$	K^+	Ca^{++}	Mg^{++}	CO_3H^-	$SO_4^=$
80	40	70	200	150	40	0.5	2-3

Micronutrients (ppm)						
Fe	Mn	Zn	B	Cu	Mo	
2	1	1	0.6	0.1	0.1	

Nutrient requirement

elemental concentration

100 ppm N Solution Contains the Following Elemental ppm		
Nitrate - N	(NO_3)	13.3
Ammonium - N	(NH_4)	7.1
Urea – N	(Urea)	79.5
Phosphorus	(P)	15.7
Potassium	(K)	56.4
Calcium	(Ca)	0.0
Magnesium	(Mg)	0.6
Boron	(B)	0.080
Copper	(Cu)	0.040
Iron	(Fe)	1.500
Manganese	(Mn)	0.220
Molybdenum	(Mo)	0.040
Zinc	(Zn)	0.060

F1313

Total nitrogen (N) 25%
1.79% ammoniacal nitrogen
3.33% nitrate nitrogen
19.88% urea nitrogen
Available phosphate (P2O5) 9%
Soluble potash (K2O) 17%
Magnesium (Mg), total 0.1500%
0.1500% water soluble magnesium (Mg)
Sulfur (S) total 2.3000%
2.3000% combined sulfur (S)
Boron (B) 0.0200%
Copper (Cu) 0.0100%
0.0100% chelated copper (Cu)
Iron (Fe) 0.3750%
0.3750% chelated iron (Fe)
Manganese (Mn) 0.0560%
0.0560% chelated manganese (Mn)
Molybdenum (Mo) 0.0100%
Zinc (Zn) 0.0162%
0.0162% chelated zinc (Zn)

Derived from: urea, ammonium sulfate, potassium phosphate, potassium nitrate, magnesium sulfate, boric acid, iron EDTA, manganese EDTA, zinc EDTA, copper EDTA, ammonium molybdate

Potential Acidity: 810 lb. Calcium carbonate equivalent per ton. Information regarding the contents and levels of metals in this product is available on the internet at: http://www.aapfco.org/metals.html

WARNING: This product contains Molybdenum (Mo) and may be harmful to ruminant animals foraging on grass where applications have been made.

NUTRIENT REQUIREMENT

a) pH

Strawberries: 5.5 – 6.0
Blueberries: 4.5 -5.5
Blackberries: 5.8- 6.5

pH higher than 7 cause plant deficiencies

Iron deficiency

NUTRIENT REQUIREMENT

a) pH

Check every day! DRIP AND DRAIN

pH is affected by the substrate pH, fertilizer cations/anions ratio, plant uptake and source water alkalinity

Iron deficiency

Kubota Lab, The Ohio State University

NUTRIENT REQUIREMENT

a) pH

How pH can change?

Normal → Slow increase in pH due to NO3 uptake

Not normal → Decrease in pH → Due to oxidation and deterioration of roots (Old plants) or presence of bacteria

NUTRIENT REQUIREMENT

a) EC

- Very sensitive to high salt levels
- If EC exceeds 1.2 dS/m → Irrigation with water

CAUTION → 'Water-rich' flavor

- Recommended EC level: 1 dS/m or less

IRRIGATION- Strawberries

Strawberry plants are sensitive to **low** and **high** humidity in substrate

Recommendation: Small amount of solution (~30 ml) per irrigation (frequently) rather than few large irrigation per day.

Avoid large fluctuation in substrate humidity

IRRIGATION- Strawberries

IRRIGATION DEPENDS ON YOUR GREENHOUSE ENVIRONMENT

We must irrigate based on evapotranspiration rate levels

a) Greenhouse relative humidity
b) Solar radiation
c) Temperature

EXAMPLE: From 6 to 12 irrigation events per day

IRRIGATION- Strawberries

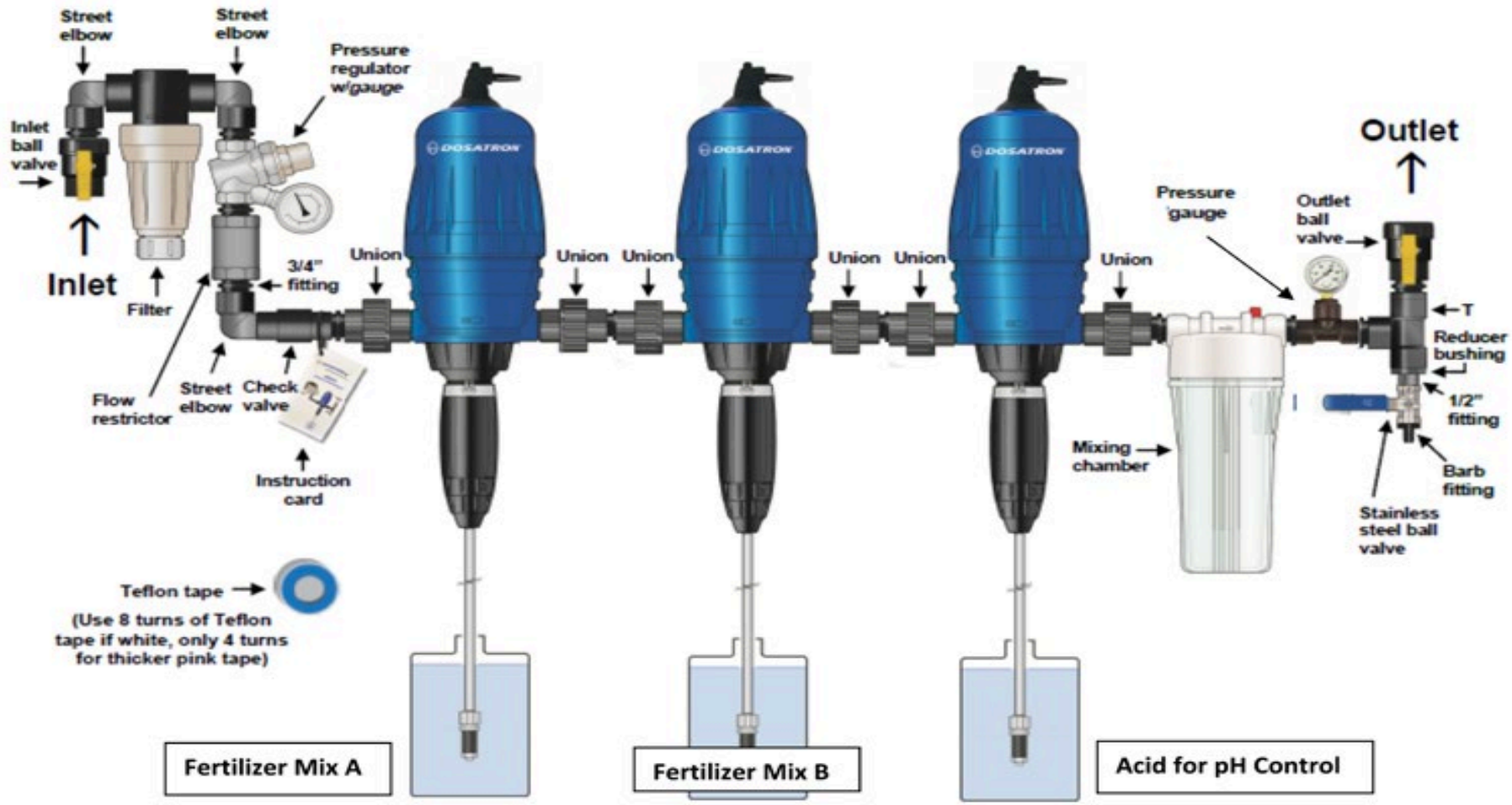
Irrigation:

- About 33 ml solution per irrigation
- About 200 mL to ~400 mL per plant per day
- Increase frequency as needed to get ~20 - 30% drainage

Injectors

Drip irrigation

Kubota Lab, The Ohio State University

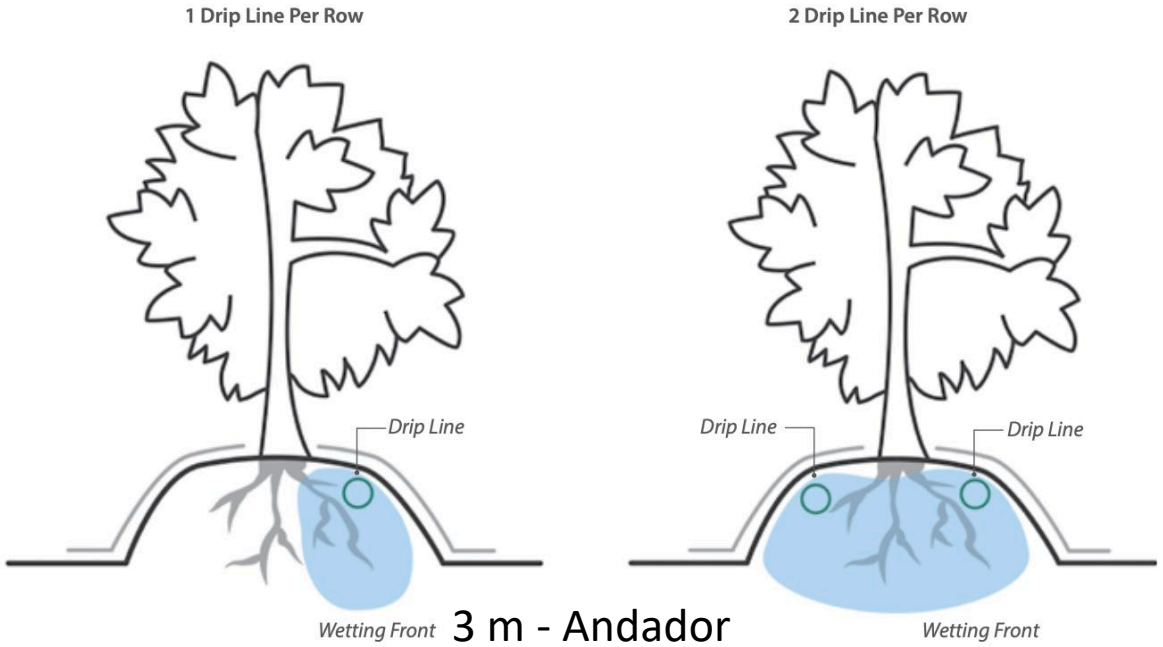

Street elbow
Street elbow
Pressure regulator w/gauge
Inlet ball valve
Inlet
Filter
3/4" fitting
Union
Union
Union
Union
Union
Union
Outlet
Pressure gauge
Outlet ball valve
T
Reducer bushing
1/2" fitting
Barb fitting
Stainless steel ball valve
Flow restrictor
Street elbow
Check valve
Instruction card
Mixing chamber
Teflon tape
(Use 8 turns of Teflon tape if white, only 4 turns for thicker pink tape)
Fertilizer Mix A
Fertilizer Mix B
Acid for pH Control

Irrigation in Blueberries

- Sensible to high fluctuations
- Irrigation events not higher than 15 min
- ~0.15 inches per hour
- Drainage 10-20%

Irrigation in Blueberry

At least **two drippers** per 25 L pot



3 m - Andador

Density
1.50 m plant/ plant

Substrate humidity
40% a 50%

Drainage: 1—20%
Irrigations per day: 3 to 10
Volume per irrigation event: 80 to 150 ml

Irrigation in Blueberries

Irrigation events will depend on environmental conditions

Irrigation can be scheduled and complemented by evapotranspiration in the system based on:

a) Relative humidity
b) Solar Radiation
c) Temperature

Blueberries: 1.5 to 3 L of water per plant

Irrigation in Blackberry

Volume per plant: 100-250 ml

Drainage: 20- 30%

Irrigation frequency: 4 to 15 irrigations per day.

Environmental Control

STRAWBERRIES

Rootzone environmental conditions

Optimizing substrate physical, chemical, and biological properties can increase the overall yield of strawberry by ~30%

Kubota Lab, The Ohio State University

ENVIRONMENTAL CONTROL

Rootzone environmental conditions

SUBSTRATE pH

Recommended levels → 5.5 – 6.0

Will help to maintain the root zone pH at around 6.0 – 6.5 after fertigation.

ENVIRONMENTAL CONTROL - Strawberries

AIR TEMPERATURE

First how do understand temperature in plants?

- **Day Temperature** - Photosynthesis
- **Night temperature** – Respiration → Fruit quality
- **Average daily temperature**- Development and growth

ENVIRONMENTAL CONTROL - Strawberries

- AIR Temperature

- Higher photosynthetic capacity → 20 C (68 F)
- **Low night temperature improves flavor**

  Day temperature: 20 - 24 C (68- 75 F)

  Night temperature: 10 – 15 C (50 F- 59 F)

  Temperature below 50 F → Affects photosynthesis

ENVIRONMENTAL CONTROL - Strawberries

- AIR Temperature

When night temperature increases and exceed 16-18°C (60-65°F), titratable acidity increases, reducing the sugar-acid ratio.

ENVIRONMENTAL CONTROL - Strawberries

- AIR Temperature

24-h average temperature around 18°C (64°F)

ENVIRONMENTAL CONTROL - Strawberries

ROOT TEMPERATURE

AIR TEMPERATURE → Affects fruit

ROOT TEMPERATURE → Affects crown → Leaves/ Flower development

ENVIRONMENTAL CONTROL - Strawberries

Temperature

ROOT TEMPERATURE

Dr. Chieri Kubota examined the crown temperature control in collaboration with Dr. M. Okimura at Kyushu Agriculture Experiment Station in Japan and achieved ~10% yield increase during our winter production seasons between 2009 and 2011

TEMPERATURE: 18 C (64 F)

Kubota Lab, The Ohio State University

ENVIRONMENTAL CONTROL

Temperature

Chilling hours

Amount of hours where the plant is in an environment with a temperature below than 7 C

They represent an amount of hours required to finish dormancy for some plants and cultivars.

Blueberry requirements: From 500 to 1000 h (Depends on the cultivar)

Blackberry typical cultivars: 200-800 h

ENVIRONMENTAL CONTROL – Blueberries

- Air temperature

Increase flower number: 20 and 23 °C
68 to 73 F

Promote flower abortion: 31 °C (87 F)

ENVIRONMENTAL CONTROL – Blackberries

- Air temperature

Increase flower number: 22- 28 C Day (Optimal)

ENVIRONMENTAL CONTROL

- LIGHT

In strawberry we need to focus in mainly two aspects

LIGHT INTENSITY → DLI

PHOTOPERIOD

ENVIRONMENTAL CONTROL

LIGHT INTENSITY → DLI

INSTANTANEUS LIGHT PPFD →µmol/m2/s

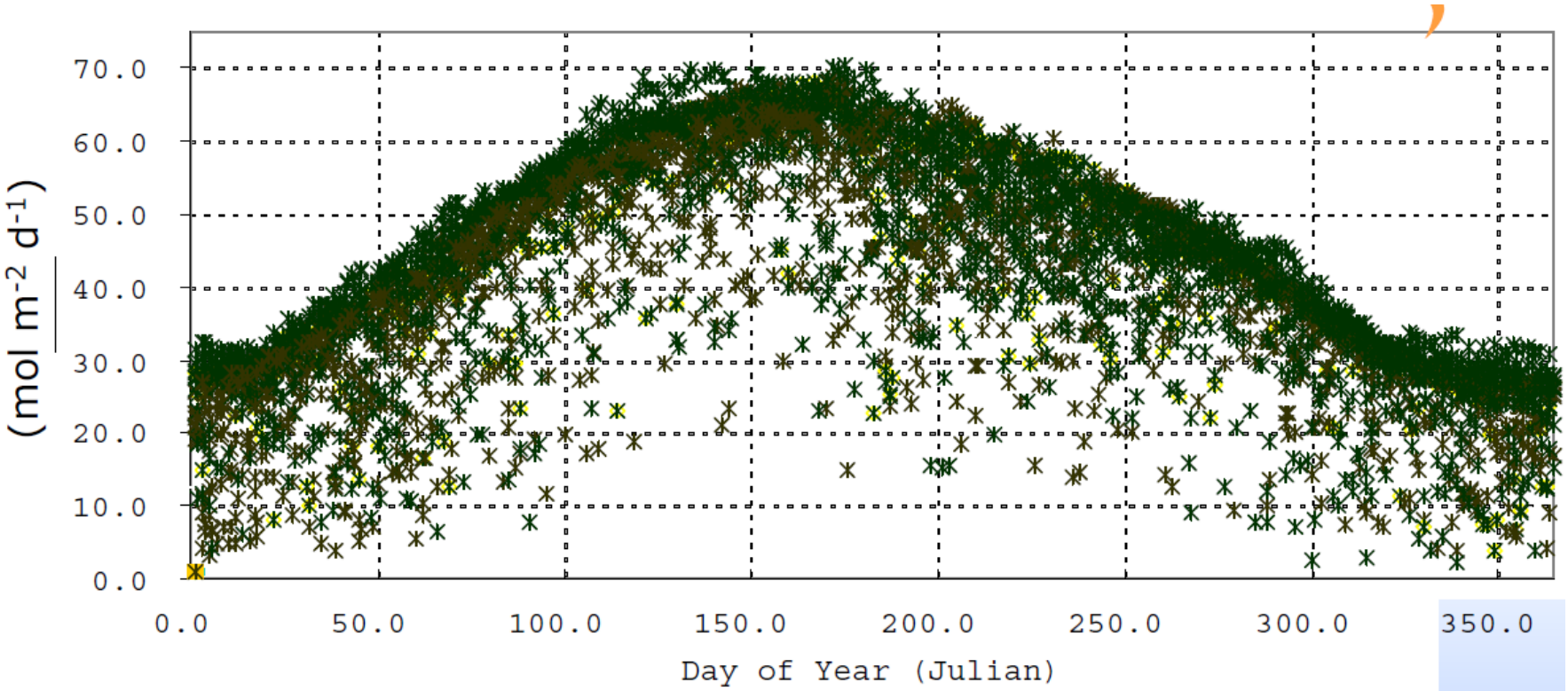
DLI→ mol/m2/d

OPTIMUM DLI FOR STRAWBERRY

20 mol/m2/d

MINIMUM → 12 mol/m2/d

DLI- example



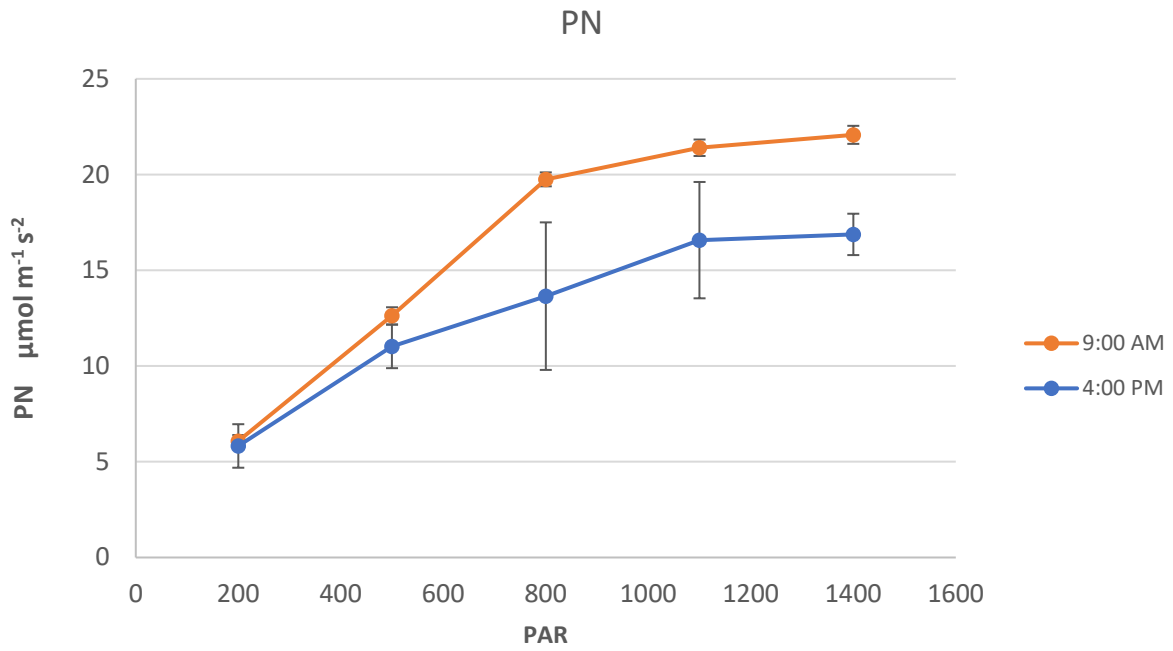
Kania and Giacomelli (2002)

ENVIRONMENTAL CONTROL

LIGHT MANAGEMENT FOR STRAWBERRY

Light saturation point reported at

800 and 1200 µmol/m2/s



ENVIRONMENTAL CONTROL

LIGHT MANAGEMENT FOR STRAWBERRY

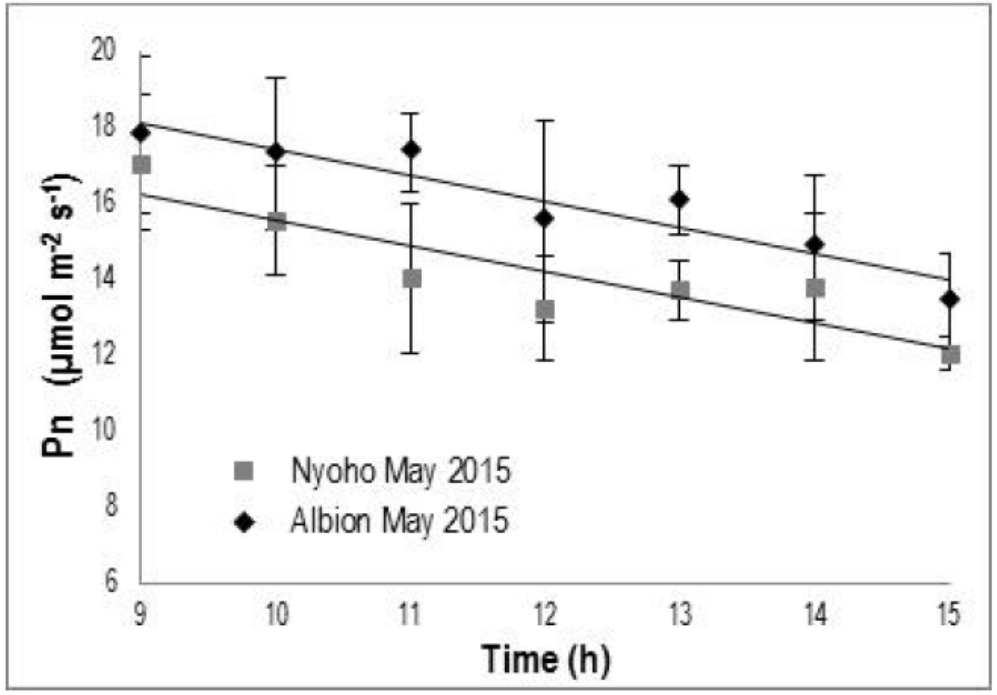
WHY IS IMPORTANT?

ARTIFICIAL LIGHTING

SHADING

ENVIRONMENTAL CONTROL

LIGHT MANAGEMENT FOR STRAWBERRY



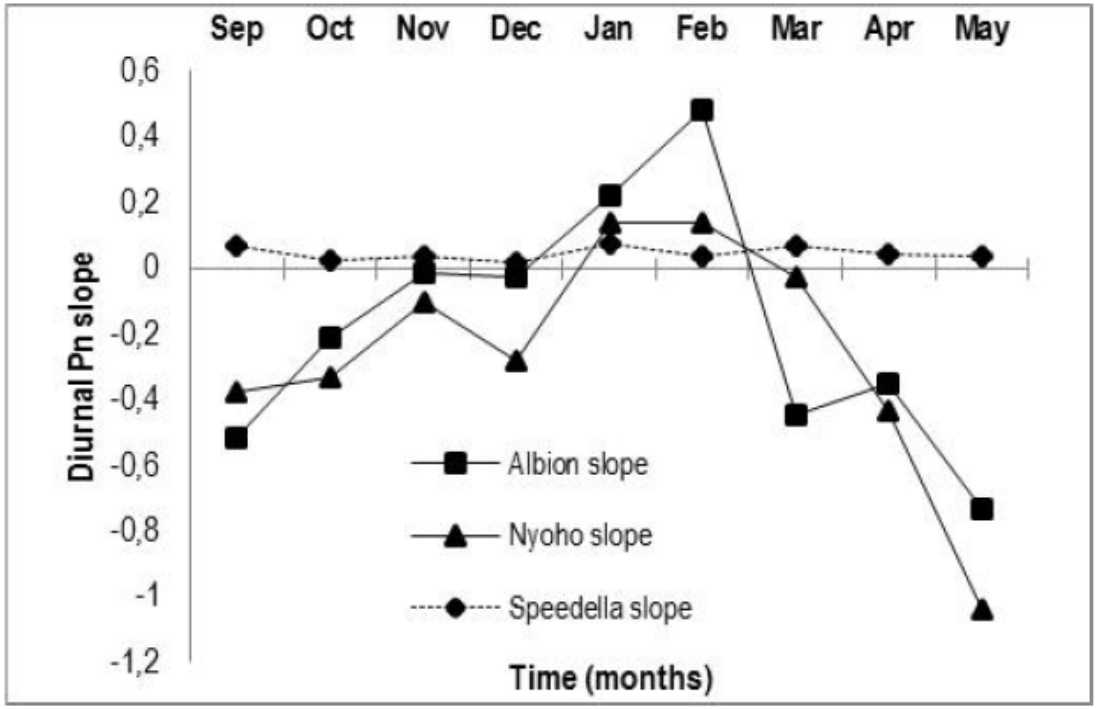
Negative feedback in photosynthesis

Morning hours are critical time for promoting photosynthesis when negative feedback of photosynthesis is occurring and could lead to develop practices in strawberry production in CEA in order to maximize production.

Garcia and Kubota, 2017

ENVIRONMENTAL CONTROL

LIGHT MANAGEMENT FOR STRAWBERRY



Negative feedback in photosynthesis

Negative slope is higher in months where more light is present in the greenhouse

LOTS OF LIGHT CAN AFFECT PN

Garcia and Kubota, 2017

ENVIRONMENTAL CONTROL

- LIGHT

In strawberry we need to focus in mainly two aspects

LIGHT INTENSITY → DLI

PHOTOPERIOD

Plant photoperiodic response basics

Photoperiodic response types

- **Long-day**
  - Facultative long-day
  - Obligate long-day
- **Short-day**
  - Facultative short-day
  - Obligate short-day
- **Day-neutral** (i.e., No response to photoperiod)

California Strawberry Commission, 2014; Whitaker et al., 2015; Oregon Strawberry Commission, 2014

Strawberry cultivars classification based on photoperiodic response

Conventional classification of strawberry cultivars

- June-bearing (Short-day)
- Ever-bearing (Long-day)
- Day-neutral

Base of conventional classification

Genetic background

- Based on parents from crosses
- Genetic markers

Open field responses

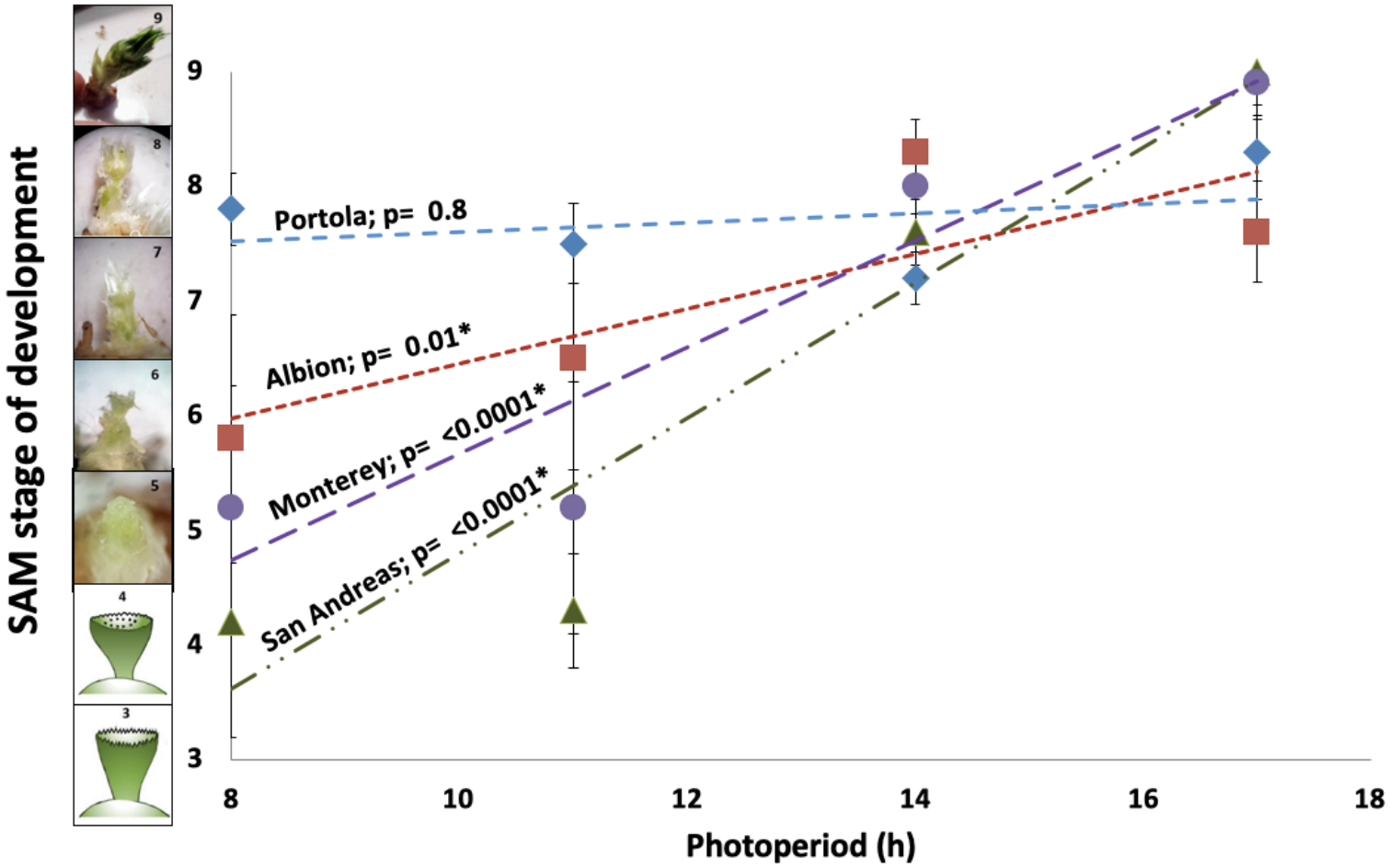
Observation

California Strawberry Commission, 2014; Whitaker et al., 2015; Oregon Strawberry Commission, 2014

COMMON CULTIVARS

Name	Type	Patent/release
Albion	Day neutral/ever-bearing	2006 (UC Davis)
Portola	Day neutral/ever-bearing	2009 (UC Davis)
San Andreas	Day neutral/ever-bearing	2009 (UC Davis)
Monterey	Day neutral/ever-bearing	2009 (UC Davis)
Ventana	June-bearing (short day)	2003 (UC Davis)
Benicia	June-bearing (short day)	2012 (UC Davis)
Chandler	June-bearing (short day)	1984 (UC Davis)
Florida Radiance	June-bearing (short day)	2008 (UF/IFAS)
Florida Sensation	June-bearing (short day)	Pending?
Camino Real	June-bearing (short day)	2002 (UC Davis)
Tillamook	June-bearing (short day)	?? (Washington State Univ.)
Puget Crimson	June-bearing (short day)	2012 (Washington State Univ.)

REAL PHOTOPERIODIC RESPONSE



Garcia and Kubota, 2017

ARTIFICIAL PHOTOPERIOD

SHORT DAY

Storage room

LONG DAY

Period for flowering induction: ~8 weeks

ENVIRONMENTAL CONTROL: Blueberries and Blackberries

- Humidity

- **Day:** 50% to 65%
- **Night**: 75-80%

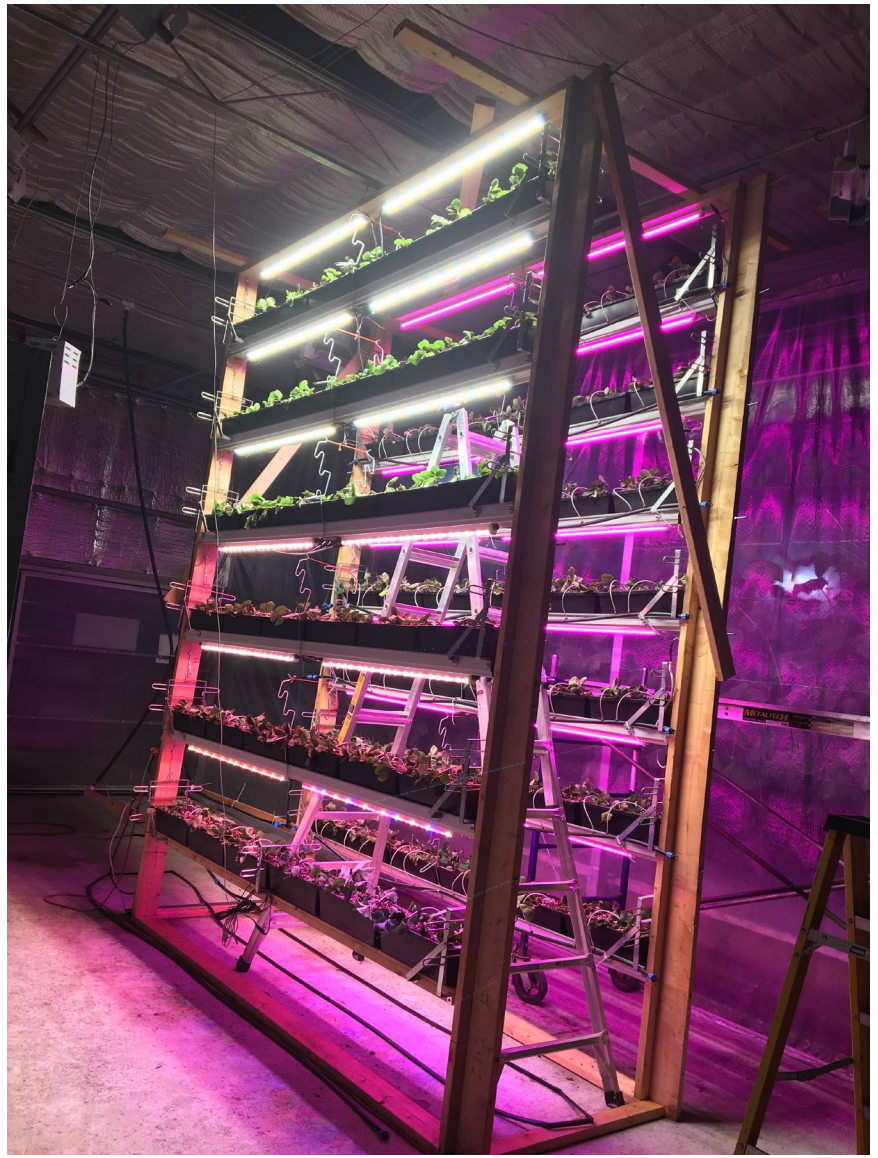
INDOOR PRODUCTION

Light quantity in strawberry

Light intensity research has shown light intensity around 200 to 250 µmol m-2 s-1 can have good results food indoor and supplemental lighting on strawberries.

This crop seems to be more sensitive to high light intensity than other common crops.

In greenhouse applications we know recommended DLI levels can go from 17 to 20 mol m-2 d-1. However light intensity used in research done in indoor facilities can point to maintaining low DLI levels in order to have better overall results and better benefits from the light quality provided.



INDOOR PRODUCTION

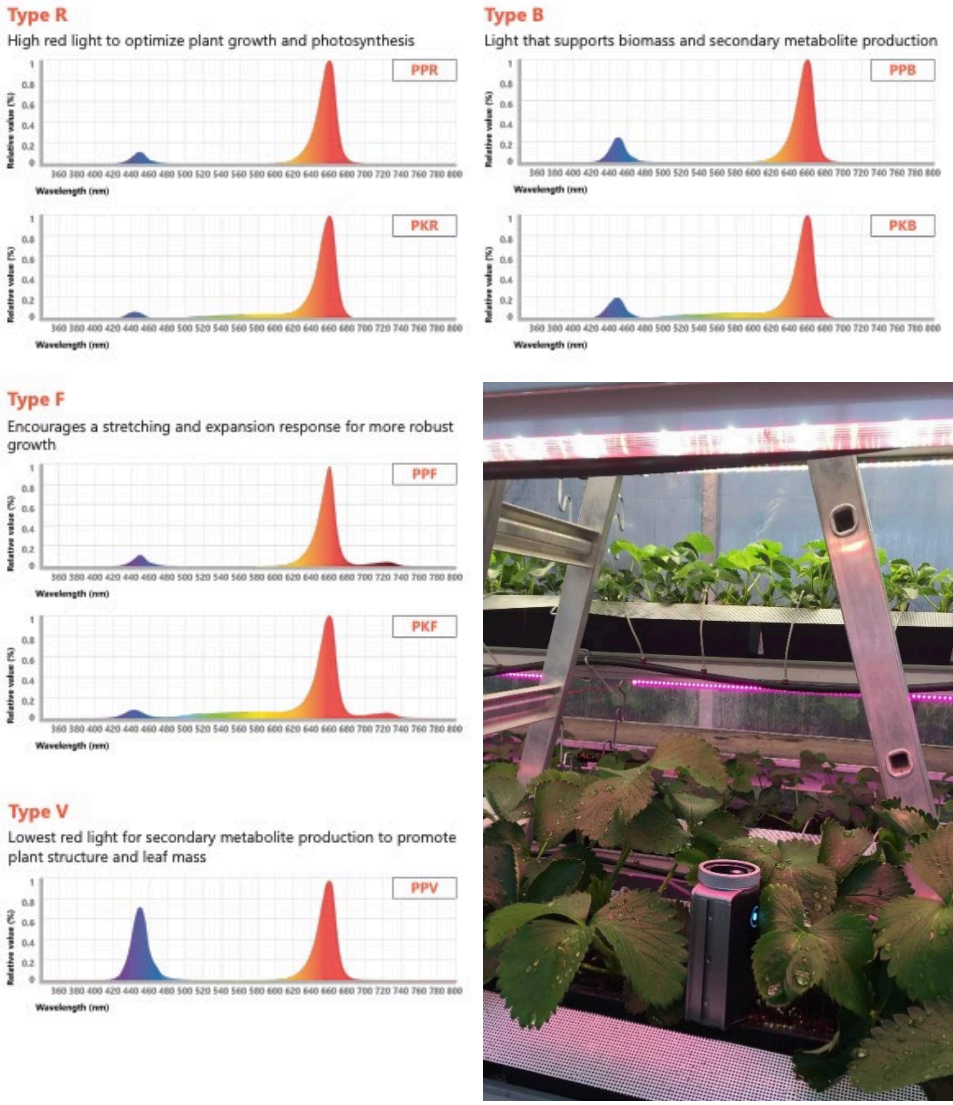
Light quality in strawberry

Research done by the research foundation Proefcentrum Hoogstraten in Belgium demonstrated the importance of Far-red light for strawberries.

This research suggests that the addition of 5% of Far- Red light to the light spectrum can be a real advantage for strawberry plant development.

A fuller, more elongated crop is created. In this research, the best light quality for strawberry was reported using 7% Blue, 16% Green, 72% Red, and 5% Far-Red.

More recent research has also concluded far-red can have a good impact on yield, plant morphology, and fruit quality.



ENVIRONMENTAL CONTROL

- Humidity

- Strawberry:

A) DAY 50-60%
B) NIGHT 75%

- Blueberry:

A) DAY 50-70%
B) NIGHT 70-85%

- Blackberry:

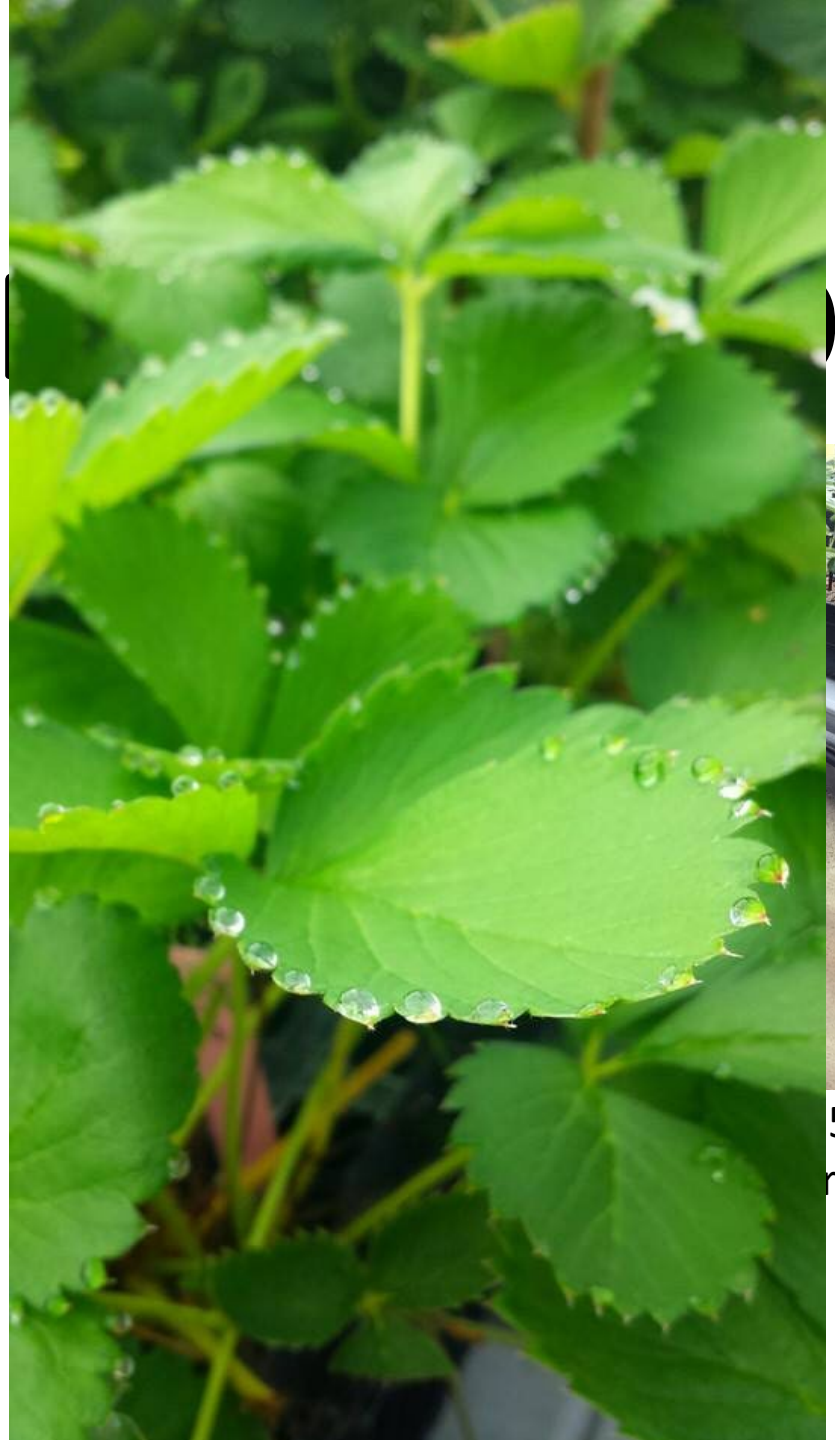
A) DAY: 60-75%
B) NIGHT 75% 85%

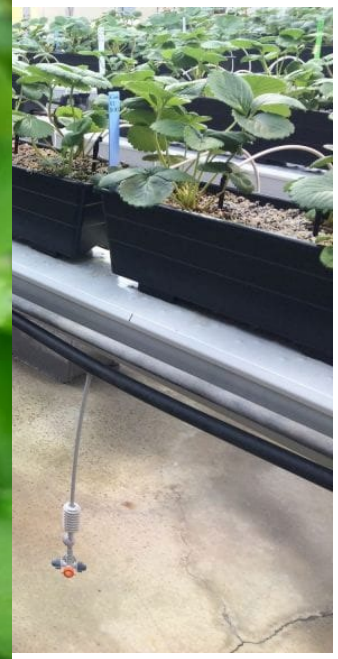
ENVIRO NTROL

- Humidity

HOW TO AVOID IT?

- **Good night RH**
- **Induce gutation**





5% relative humidity at plant
r night (Recommended for

ENVIRONMENTAL CONTROL

Air speed

WIND

- Forced ventilation:

0.2 to 1 m s^{-1}

*** For growing lettuce vertical airflow fans are recommended**

Air velocity sensor

CROP MANAGEMENT

POLLINATION

wberry

linator

e strawberry
greenhouse
er m2

Kubota Lab, The Ohio State University

Bumblebees more common for greenhouse production:

Bumblebees work well in greenhouse tomato and their use is an industry standard.

Introduction of bumblebees to strawberry greenhouse is possible.

MORE ACTIVE THAN HONEYBEES

~20 bees per 1,000 sq feet

Pollination

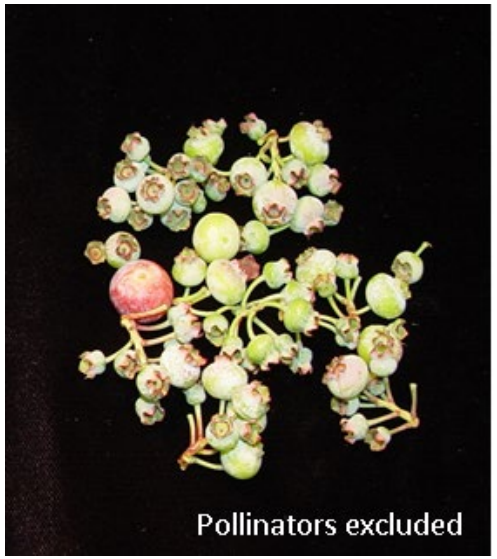
CAUTIONS:

- When the bumblebee population is high relative to the number of flowers, bumblebees tend to damage the flower and receptacle by making too many visitations
- How avoid problems..
- Limit the bee's access to the crop by temporarily closing flight holes (exit for bees).
- Provide supplemental pollen to the hive

Each pistil must be pollinated

POLLINATION-Blueberries

The flower needs to be pollinated in 3 days



Without pollinators

With pollinators

POLLINATION- Blueberries

Cultivar	Honey bee hives/acre	
	Low rate	High rate
Rubel, Rancocas	0.5	1
Weymouth, Bluetta, Blueray	1	2
Bluecrop	1.5	3
Elliot, Coville, Berkeley, Stanley	2	4
Jersey, Earliblue	2.5	5

The use of pollinators can increase number of fruit in 70%

Honey bees: 6 to 10 hives per hectare

Bumblebees: 3 to 4 hives per acre (~200 bumblebees per hive)

YIELD

How much should I expect?

STRABERRY YIELD

Kubota Lab, The Ohio State University

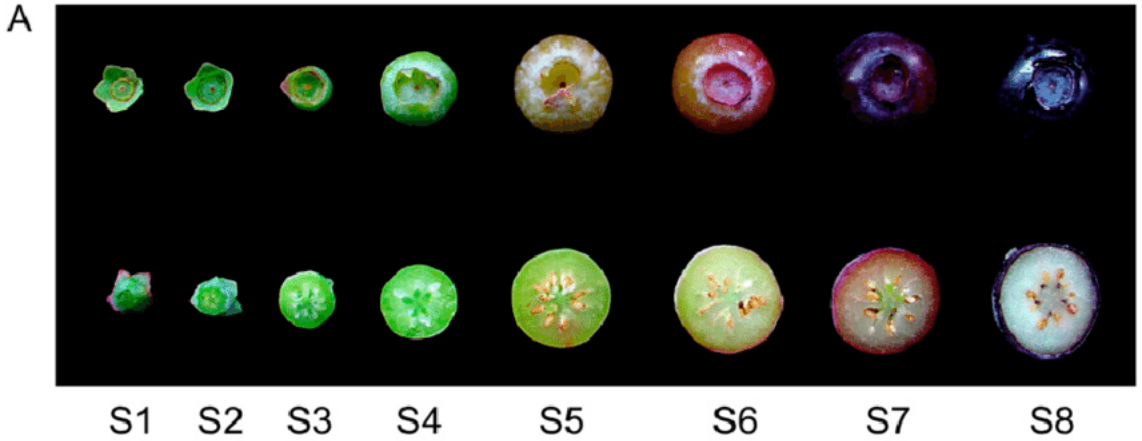
(2013-2014 data at UA CEAC, Means ± S.E.)

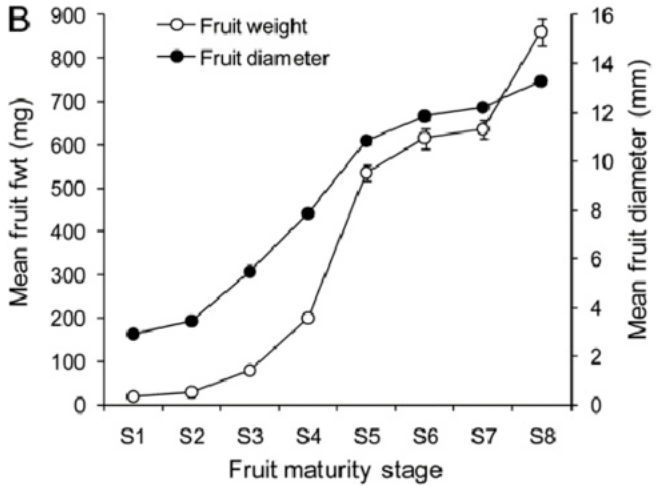
	Albion (Ever-bearing)	Portola (Ever-bearing)
Cum. Yield (kg/m2)	9.68 ± 0.43 kg/m^2	12.62 ± 0.70 kg/m^2
Cum. Yield (kg/plant)	*1.21 kg/plant*	*1.58 kg/plant*
Avg. fruit size (g/fruit)	19.7 ± 1.4 g (max 51.8 g)	24.4 ± 1.2 g (max 52.1 g)
Brix (TSS)	7.9 ± 0.11 %	5.8 ± 0.17 %
TA (citric acid eq.)	10.5 ± 0.14 g/L	8.6 ± 0.17 g/L
Vitamin C (ascorbic acid)	407 ± 12.6 mg/kg FW	301 ± 7.6 mg/kg FW
		

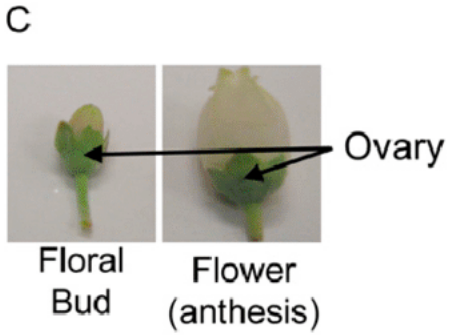
BLUEBERRY YIELD

- **Flower to fruit**: 30 days
- **Usually takes 10 years** to have a mature plant
- In hydroponics good yield can be reached from the **first and second year** of production.

Plants from 3 to 5 years old yield better in hydroponics







BLUEBERRY YIELD

HYDROPONIC PRODUCTION
15 tons / Hectare

SOIL PRODUCTION
10 Tons/ Hectare

BLACKBERRY YIELD

3- 5.5 KG PER PLANT (5-6 MONTHS CYCLE)

- 100% blueberry production is hydroponic, pH in soil is high (pH: 8)
- Pots used → 27 L and 45 L
- Grower claims pots are better than bags: Improves drainage, rootzone aeration and root development. Allow to pull out the plant without making damage, to check roots or add more substrate. The pot allow to have the plant with enough separation from the soil. The plastic bag must be replaced every 4 years
- **Benefits in use of coconut coir:** Less weed development
    a) Every year more substrate is added to the pot
    b) To avoid weed development and keep rootzone in better condition the upper part of the pot contains the most fine part of the coconut coir
    c) Substrate porosity: 70% → Is good to have high porosity because with out porosity tends to be reduced.
- **Complete cycle of production:** Maximum 6 years.
- **Average production:**
    a) 1st year: 2 kg per plant
    b) 2nd year: 3 kg
- **Harevst time:** Takes 2 months from flower to fruit
    a) Once harvest time initiate plants are harvested every 10 days.
- **Plant density:** 65 cm between plants/ Walk way 2.4 m
- **Window of production:** January, February, March and April
- **Pollination:**
    a) For 4 months
    b) 6 hives per hectare (Honey bees)
    c) Pollination can also be done by robots by shaking the plants. Grower claims is more expensive than bees and not sure about the results yet.
- **Nutrients**
    a) Are divided by stage of development: Vegetative, Flower differentiation, Harvest, Post Harvest.
    b) Cost of fertilization: 7,000 USD per hectare
    c) Drainge used: 35% to 40%
    d) Nutrient/ water use per day (average): 3 L per plant
- **Pruning**: Copper and vinyl paint is applied to avoid spread of diseases.
    a) Is done 5 months after planting
    b) 6 months after production/ Every June
    c) Plant height: 1.5 m / Short cultivars: Sequoia pop / Sequoia Jupiter

ON SITE REPORT

ON SITE REPORT

Blueberry

- **Production:**
  a) 1 year: 2 kg per plant → Atlas
  b) 1 year: 3 kg per plant → Sequoia pop
- **Full cycle production:** 7 years
- **Irrigation:**
  a) 12 to 14 times per day
  b) Drainage: 15 to 20%
  c) Nutrients/ Water per day → 3 L

Raspberry:

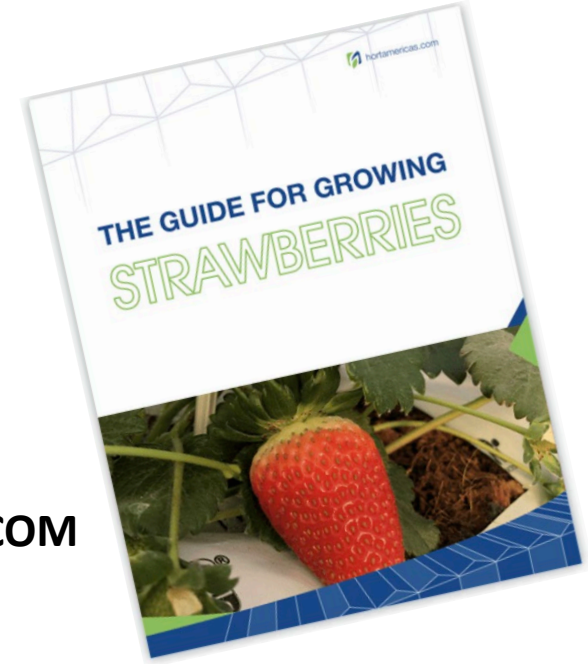
- **Pots:** Grower claims 7 L per pot is low volume, he recommend to use 20 L.
- **Density:** 10,000 pots per hectare

Blackberry:

- **Density:** 4,800 plants per hectare
- **Full cycle:** 5 years

FOCUS!

- ✓ – Strawberry hydroponics growing systems
- ✓ – Nutrient requirement
- ✓ – Irrigation
- ✓ – Environmental requirements for strawberry
- ✓ – Cultivar selection
- ✓ – Crop management



QUESTIONS / CONSULTING SERVICES

TECHNICALSERVICE@HORTAMERICAS.COM

FREE STRAWBERRY GUIDE!

HORT AMERICAS TEAM

THANK YOU!