The Perfect Packingshed

MOSES Organic Farming Conference
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AGENDA FOR THE SESSION

• What IS a packingshed?
• What IS postharvest handling?
• Food safety concerns
• Shelf life and quality
• Infrastructure options
• Putting the pieces together
• Questions
The Perfect Packingshed...

- Decreases Liability (Food Safety)
- Increases Efficiency
- Increases Shelf-Life
  - Increases Salability
  - Good Products Sell Themselves

But, the Perfect Packingshed is...

IMPOSSIBLE!
Why the Mediocre / Just Alright Packingshed works...
What is a packing shed?
Where your Post-Harvest Handling happens and your Post-Harvest Handling Infrastructure lives!
What is Post-Harvest Handling?

Everything that happens to your farm goods from the moment of harvest to the moment they land in your buyer’s hands.
What is Post-Harvest Handling Infrastructure?

Any building, structure, equipment, machinery, or food-contact surface involved in any part of post-harvest handling.
Why is Post-Harvest Handling Important?

This is the step for most farms in the seed-to-sold process where things are most likely to go wrong.
Why We Have to Talk About Food Safety

The CDC estimates that each year foodborne illnesses in the US result in an estimated:

- 47.8 million cases of food poisoning; **1 in 6 Americans**
- 127,839 hospitalizations
- 3,037 deaths

- Approximately 12.3% of these illnesses are traced back to fresh produce, and only **2% are traced to practices on the farms that grow the produce**. Still, that’s more than 960,000 illnesses per year that are traced to **on-farm practices or conditions**, and that means the rest of the food system is starting to demand that farms improve their food safety practices.

-From Wholesale Success
### Worst Foodborne Illness Outbreaks in the USA

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Company</th>
<th>Cases</th>
<th>States</th>
<th>Hospitalizations</th>
<th>Deaths</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2003) Hepatitis A</td>
<td>Chi Chi’s</td>
<td>565</td>
<td>7</td>
<td>130</td>
<td>3</td>
<td>Fresh Green Onions</td>
</tr>
<tr>
<td>(2006) E. Coli 0157:H7</td>
<td>Dole</td>
<td>238</td>
<td>26 + 1 in Canada</td>
<td>103</td>
<td>5</td>
<td>Fresh Spinach</td>
</tr>
<tr>
<td>(2011) Listeria</td>
<td>Jenson Farms</td>
<td>147</td>
<td>28</td>
<td>143</td>
<td>33</td>
<td>Cantaloupe</td>
</tr>
<tr>
<td>(2015) Salmonella</td>
<td>Andrew and Williamson</td>
<td>907</td>
<td>40</td>
<td>204</td>
<td>6</td>
<td>Cucumbers</td>
</tr>
<tr>
<td>(2018) E.Coli 0157:H7</td>
<td>Yuma Growing Region</td>
<td>210</td>
<td>36</td>
<td>96</td>
<td>5</td>
<td>Romaine Lettuce</td>
</tr>
<tr>
<td>(2019) E.Coli 0157:H7</td>
<td>Salinas, CA Growing Region</td>
<td>138</td>
<td>25</td>
<td>72</td>
<td>0</td>
<td>Romaine Lettuce</td>
</tr>
</tbody>
</table>
Where Do Pathogens Live?
EVERYWHERE!
Listeria monocytogenes

WHAT IS IT?
Pathogenic bacteria that causes the infection listeriosis. It is an anaerobic bacterium, capable of surviving in the presence or absence of oxygen.
Ability to grow at temperatures as low as 0 °C permits multiplication at typical refrigeration temperatures.
Listeriosis

WHO IS SUSCEPTIBLE?

• People 65 years of age and older are four times more likely to get Listeriosis than the general public

• Pregnant women are ten times more likely to get listeriosis

• Young children and others with weakened immune systems are also at risk of contracting listeriosis

WHY IT MATTERS

• Third leading cause of death from food poisoning

• Some people have reported symptoms starting as late as 70 days after exposure or as early as the same day of exposure

• Used to be involved with deli meats and hot dogs, while recently has been affecting produce and dairy products
How the &%$ is Listeria In a Packingshed?

A packingshed is not a sterile environment

Other risks are present on a farm

Equipment is hard to keep clean

Produce is generally grown in soil and is therefore DIRTY
Reducing Listeria

Germ Farm

Scrub'em!

www.1st-in-handwashing.com
<table>
<thead>
<tr>
<th>Task</th>
<th>Frequency</th>
<th>Bins/Containers Washed &amp; Sanitized</th>
<th>Food Contact Surfaces</th>
<th>Cooler Floors and Drains Washed</th>
<th>Cooler Floors and Drains Sanitized</th>
<th>Transport Vehicles Washed and Sanitized</th>
<th>Equipment and Utensils Washed and Sanitized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place Date and Initials in Each Square</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provided Under Each individual Task.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date: Preventive Maintenance:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date: Preventive Maintenance:</td>
<td></td>
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<td></td>
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<tr>
<td>Date: Preventive Maintenance:</td>
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<td></td>
</tr>
<tr>
<td>Date: Preventive Maintenance:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reviewed By:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Flow Zones

Field

Cottle Organics
Packing House

Farm Office

3-Way Sink

Water Source

Packing Supply Area

Misc. Storage

Vat

Field

Truck
Wet Zone-Area

Potential Risks:

- **Listeria** – Source: Cracks and drains; Can grow at refrigeration temperature; Multiplies by feeding off of organic matter in soils.
- **Salmonella** – Source: Fecal Matter in sinks from handwashing
- **E.Coli** – Source: Non-Potable Water

Know your pathogens to determine your risk!
Dry Zone-Area

Potential Risks:

- Tracking water/dirt/debris from Wet Zone
- Pest and rodent harborage
- Overhead contamination (Dirt, glass)
- Chemical storage
- Workshop
ZONES

ZONE 1

Direct food contact surface
Tables, Sinks, Dunk Tank, Barrel Washer, Containers, Hands, Gloves

ZONE 2

Non-food contact surfaces that come into contact with a Zone 1
Light switches, table edges, faucets, pens and markers, cell phone, clothing, Shelving, Door handle

ZONE 3

Surfaces within your packingshed
Walls, Table legs, Drains, Fans, Rafters, Overhead storage, Delivery vehicle, Shelving, Doorknobs

ZONE 4

Floors, Ground, Outside areas, Animal areas
Compost pile, Yard, Cooler floor, Loading dock, Entrance
If you were asleep during the Food Safety section... Remember these important points...
• **Handwashing is critical:** Ensure you have adequate handwashing stations in your packing shed. You may need more than one and consider putting one outside your main entrance to your packing shed.

• **Keep Zone 1 surfaces clean and sanitized:** Brush washer sponges, sorting tables, scales, knives, dunk tanks.

• **Eliminate standing water:** Keep drains clear and ensure your flow zones do not go over water.

• **Take pictures of your packingshed setup:** Label the zones, share with a farmer friend to do the same and get feedback.

• **Keep your coolers clean and sanitized:** As one of the final zones before going to market, it is critical to keep these areas clean. (Remember cooler curtain strips)

• **Make records fit your farm!**

• **Grow your packing shed with food safety in mind:** Stay up to date with food safety requirements for GAP and FSMA in case you ever need it!
Shelf-Life and Quality

Food Safety improvements generally also improve Quality, Shelf-Life and Efficiency
Shelf-life and Quality =
How do I keep my product looking as good as it did the day I harvested it as the day the final customer eats it?
What Is Ideal Shelf-Life?

CSA AND FARMERS MARKETS
A MINIMUM OF ONE WEEK

WHOLESALE
A MINIMUM OF TWO WEEKS
**Wholesale Cilantro**

**Monday:** farmer harvests three cases of cilantro on a little farm in Maine

**Tuesday:** I receive cilantro from farmer and store it in a walk-in cooler

**Thursday:** cilantro is delivered to a distributor, where it is stored in a walk-in cooler

**Saturday:** distributor delivers cilantro to a grocery store in Boston

**Monday:** grocery store displays cilantro

**Wednesday:** customer purchases a bunch of cilantro

**Saturday:** customer makes tacos for dinner with cilantro harvested 13 days ago!!
Maximizing Shelf-Life and Quality

• Healthy Plants
• Temperature When Harvesting
  ➢  Not too hot, not too cold
• Gentle and Minimal Handling
• Appropriate Packaging
• Moisture Level of Harvested and Packed Crops
  ➢  If you don’t need to wash it, don’t wash it!!
• Cold/Appropriate Temperature Storage
• Humidity Control
• Getting Field Heat Out Quickly
Post-Harvest Handling Infrastructure for Shelf-Life and Quality

- Reducing Field Heat Quickly
- Cold Storage
- Cold Transportation
- Moving Produce Through Each Step of Post-Harvest Handling
- Cleaning, Washing and Sanitizing
- Drying
- Curing and Long-Term Storage
As a wholesale-only operation, Queen’s Greens fills over a hundred orders each week during the growing season. Danya explains the systems they use to track and fulfill those orders, and the administrative structure they’ve developed to get everything delivered, even though Queen’s Greens doesn’t own a delivery truck.

We also discuss their conversion of a tobacco barn into a GAPs-audited packing shed, as well as their winter spinach production.
Farmer to Farmer Podcast
Episode 156: Steven Beltram of Balsam Gardens on Farming without Infrastructure, Growing on Plastic, and Selling Wholesale

Talks about transitioning from a small diversified, direct marketing farm in the country to a farm in Asheville on 30 acres of certified organic ground, selling 100% to wholesale distributors.

Steven digs into how he has developed a large, efficient farm without any post-harvest handling infrastructure except a covered hay wagon and a refrigerated truck. The crew field packs all crops, and Steven explains how they do this in a way that has helped them pass their GAPs audit while maintaining good quality. Steven shares how they have worked to structure their crops and their labor pool to maximize their efficiency.
<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
<th>Length (side to side)</th>
<th>Width (front to back)</th>
<th>Thickness</th>
<th>Price Range New *not including tax</th>
<th>Price Range Used *not including tax</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRP Wall Panels</td>
<td>Fiberglass Reinforced Panels; Washable, sanitizable, durable.</td>
<td>8 feet is standard; also available in 9, 10, and 12 feet</td>
<td>4 feet</td>
<td>approximately ¾ inch</td>
<td>$30 to $120 per panel</td>
<td>n/a</td>
</tr>
<tr>
<td>Stainless Steel Wall Panels</td>
<td>Washable, sanitizable, durable.</td>
<td>8 feet (or may be customized size/shape)</td>
<td>4 feet (or may be customized size/shape)</td>
<td>approximately ¾ inch</td>
<td>call companies for quotes; very expensive</td>
<td>$75+ per panel</td>
</tr>
<tr>
<td>Rubber Horse Stall Mats</td>
<td>Washable, sanitizable, durable; easier on joints and warmer during cold weather</td>
<td>6 feet</td>
<td>4 feet</td>
<td>½ or ¾ inch</td>
<td>$35 to $45</td>
<td>$10 to $20</td>
</tr>
</tbody>
</table>
Which method is best for what I grow?

Check out the
On-Farm Infrastructure Toolkit

Google On-Farm Infrastructure Toolkit CFSA

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<table>
<thead>
<tr>
<th>METHOD</th>
<th>ROOM COOLING</th>
<th>FORCED-AIR COOLING</th>
<th>HYDROPONIC COOLING</th>
<th>ICE COOLING</th>
<th>IDEAL HOUSING TEMPERATURE °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>36 – 40 °F</td>
</tr>
<tr>
<td>Asparagus</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Beans</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>30 – 40 °F</td>
</tr>
<tr>
<td>Beets, roots</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Blackberries</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Blueberries</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Broccoli</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Brussel sprouts</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Cabbage</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Carrots</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Celery</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Corn</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Cucumbers</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>59 – 65 °F</td>
</tr>
<tr>
<td>Eggplant</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>56 – 58 °F</td>
</tr>
<tr>
<td>Endive</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Leafy greens</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 – 36 °F</td>
</tr>
<tr>
<td>Lettuce</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Luffa, squash</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Peppers</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Pears</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>29 – 31 °F</td>
</tr>
<tr>
<td>Potatoes</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 – 34 °F</td>
</tr>
<tr>
<td>Radishes</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Raspberries</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>58 – 60, 68 – 70 °F</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>59 – 61, 65 – 68 °F</td>
</tr>
<tr>
<td>Tomatoes, cherry</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>45 – 50 °F</td>
</tr>
<tr>
<td>Tomatoes, plum</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Tomatoes, beefsteak</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
<tr>
<td>Tomatoes, heirloom</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>32 °F</td>
</tr>
</tbody>
</table>

Notes:
- Do not place produce directly on concrete or metal surfaces.
- Do not use chemical sprays on fresh produce.
- Do not wash or rinse fresh produce until immediately before consumption.

Source: Adapted from K. C. and J. M., USDA, University of California, 2013.
# APPENDIX A

## Comparison of Cooling Methods for Common Fruits & Vegetables on Small-Scale Farms

<table>
<thead>
<tr>
<th>METHOD</th>
<th>ROOM COOLING</th>
<th>FORCED-AIR COOLING</th>
<th>HYDRO-COOLING</th>
<th>ICE COOLING</th>
<th>IDEAL HOLDING TEMPERATURE °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling Time</td>
<td>20-100 hours</td>
<td>1-10 hours</td>
<td>0.1-1 hours</td>
<td>0.1-0.3 hours</td>
<td></td>
</tr>
<tr>
<td>Apples</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>30–31; 38–40</td>
</tr>
<tr>
<td>Asparagus</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>32 (36)</td>
</tr>
<tr>
<td>Beans</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>41–43</td>
</tr>
<tr>
<td>Beets, roots</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Blackberries</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>31–32</td>
</tr>
<tr>
<td>Blueberries</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>31–32</td>
</tr>
</tbody>
</table>
Cooling Methods

1. Forced Air Cooling
2. Ice Cooling
3. Cooling with Water
4. Refrigerated Cooling
REDUCING FIELD HEAT QUICKLY

For every 18°(F) increase in the internal temperature of produce, the rate of deterioration increases 2 to 3 times

From Wholesale Success

Ideal storage temp. for lettuce is 32°

32° + 18° = 50°

The shelf-life of most crops is reduced by a full day or more for every hour that passes between the moment of harvest and the start of cooling

From Wholesale Success
Key Points of Precooling

- Starts the cold chain by rapidly reducing respiration.
- Reduced respiration leads to higher quality over a longer storage and distribution time.
- Cooling is improved with the combination of active cooling and forced air flow with a blower.
- 1-3 CFM of airflow at 0.5 IWC static pressure per pound of product is the rule of thumb for sizing.
- Ventilated containers (e.g. holes or slats) are necessary to ensure airflow is actually through the product.
- Close up any large openings to prevent short-circuiting air flow.
Ice Cooling or Package Icing
Cooling with water
Cold Storage Options
Build-It-Yourself with Coolbot

CoolBot®
Patented

Room Fins Heater Program

Room Fins Heater Power

36
Coolbots or traditional compressors can be used in:

1. Sheds – build your own or use an existing shed
2. An indoor room
3. A trailer or box truck
4. A prefab walk-in cooler
5. Coolbot Brand Walk-in Cooler Kit
Insulated shipping container
Refrigerated Trailer

Attach to a truck, ATV, or tractor - bring to field edge for in-field cooling.

Relatively inexpensive un-interrupted cold-chain option

Doesn’t require the cost of purchasing and maintaining another vehicle
Shelves or No Shelves: Efficiency and Food Safety Considerations
Shelves or No Shelves....
Cleaning, Washing and Sanitizing
Take a look at Appendix B

CLEANING

No water is involved
Done with:
  - A clean, dry cloth
  - A soft bristled brush
  - Clean, dry cotton gloves
Which crops:
  - Tomatoes, winter squash, summer squash, melons, eggplant, okra
  - Produce that is too dirty to go directly into wash water

WASHING

Water is involved
Done with:
  - Sinks
  - Tanks
  - Spray tables
  - Mechanical wet brush washers
  - Barrel washers
Sanitizing

- Produce
- Harvest knives
- Harvest containers
- Food contact surfaces
- Hands (in separate hand-washing sink)
- Walk-in cooler
- Delivery vehicle
Hand-washing is crucial infrastructure
Clean place to store clean equipment
Small-Farm Washing and Sanitizing
Special note about root crops

SPRAY FIRST TO REMOVE SOIL

SOAK SECOND TO REMOVE FIELD HEAT (IF NECESSARY)
Spray Table Must Be Food-Safe Surface

NO!!

YES!!!
Considerations when choosing wash containers

**CONTAMINATION POTENTIAL**

Fresh-eating greens need their own, dedicated sinks

If you soak root crops, they should have their own dedicated sinks

**BATCH SIZE AND FREQUENCY OF CHANGING WATER**

It takes a very long time to fill a 250-gallon stock tank

Water needs to be changed between each type of produce

Water needs to be changed when dirty
There are MANY things wrong with this picture

... and the story of why
Barrel Washer

1. Wood vs Metal
2. Many different designs
3. Take up a lot of space
4. Moderately priced and efficient
5. Good for most root crops
Mechanical Wet Brush Washer

1. Many different styles and models
2. Can be purchased in pieces
3. Pricey but very efficient
4. Good for peppers, cucumbers, apples, peaches, melons, winter squash, round root crops
Drying
Appendix B

DRAINING AND AIR DRYING

Draining
Place upside down on screen table.
Good for lettuce, heads of Asian greens, bunches of herbs, celery

Air Drying
Lay out on screen tables in single layer
Good for root crops, melons, peppers, cucumbers, and beans/peas**

MECHANICAL DRYING

Mechanical Wet Brush Washer with absorber unit
Has rotating sponge “donuts” that remove water

Salad Green Options
Salad Green Spinners
Spray wash line with conveyor belt
What needs changing in this picture?
Salad Green Spinners
Greens Bubbler
What Do You Use Your Packshed For?

POST-HARVEST HANDLING
- Cleaning produce
- Packing
- Cooling
- Shading
- Storing produce

OTHER STUFF
- Storing totes and supplies
- CSA pick-ups
- Morning meetings and coffee
- Seeding trays
- Annual party
- Lunch
Designing the Perfect Packshed

1. Where would you put pest traps?
2. How do you control birds that fly in?
3. What does your cleaning schedule look like?
4. What are the components of a handwashing station?
5. How do you remove field heat?
6. What temperature is your cooler set at?
7. Draw the product flow zone.
If you take Food Safety, Efficiency, Shelf-Life/Quality, & Budget into account...

A mediocre packshed works just fine
The Perfect Packingshed
MOSES Organic Farming Conference
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