OPTIMIZING SOIL & PLANT HEALTH IN AGRI-FOOD PRODUCTION

Regenerative Agriculture - its benefits and innovations

PRESENTATION BY :

Eric & Ines Batterton

Owner & Founder of My Nordic Garden

Réseau Agroalimentaire de l'Est ontarien

Eastern Ontario Agri-Food Network

My NORDIC Garden

Natural & Sustainable Kitchen Gardens

MODULES

1. INTRODUCTION TO SOIL HEALTH
2. SOIL TESTING & ANALYSIS
3. BUILDING HEALTHY SOIL WITH COMPOSTING
4. PREVENTING MOULD & FUNGAL DISEASES
5. NUTRIENT MANAGEMENT & FERTILIZATION
6. ORGANIC SOIL AMENDMENTS & ALTERNATIVES
7. CROP ROTATION & PLANT PAIRING
8. WATER MANAGEMENT & IRRIGATION PRACTICES
9. INTEGRATED PEST MANAGEMENT (IPM)
10. SOIL CONSERVATION & SUSTAINABLE PRACTICES

MODULE 4:

PREVENTING MOULD & FUNGUAL DISEASES

- All Moulds are fungi but not all fungi are moulds
- Fungal diseases
- Causes of Mould & Fungal diseases
- Identifying Mould & Fungal diseases
- Preventative Measures

1) ALL MOULDS ARE FUNGI BUT NOT ALL FUNGI ARE MOULDS

Fungi:

diverse group of eukaryotic organisms that belong to the kingdom fungi; includes yeasts, moulds & mushrooms; play a role in decomposition

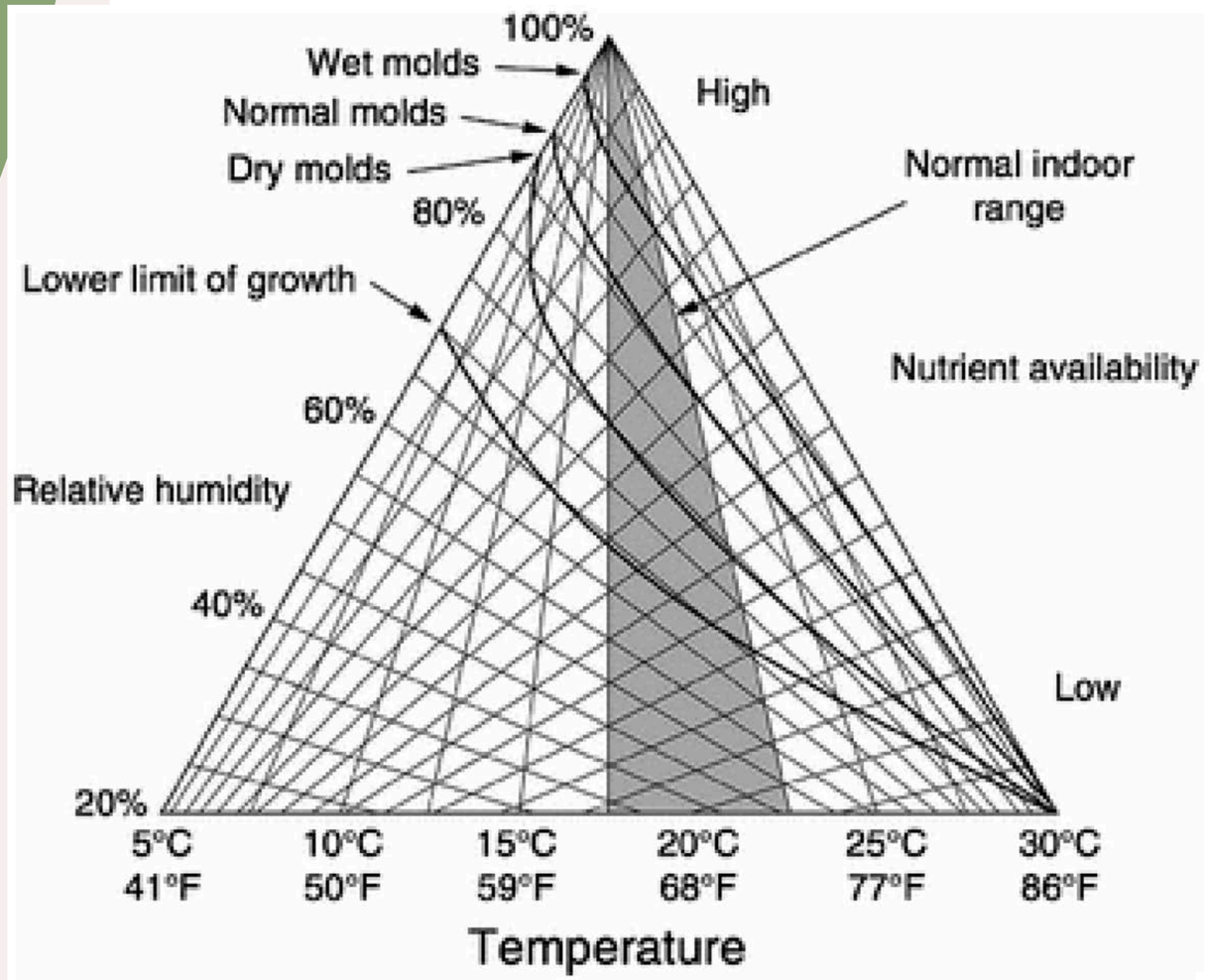
eukaryotic organisms = organisms made of cells with a real nucleus

Mould:

a ***specific type of fungus***, typically grown as **multicellular** filaments (hyphae) that form mycelium; reproduces via spores; plays a role in decomposition & nutrient cycling; optimal T range: 15°-25°C; moisture above 60%, pH 3-7

multicellular = structural form of certain fungi, composed of multiple cells, may or may not be pathogenic

CONDITIONS OF MOULD GROWTH



- Infestation (e.g. germination of mould spores)
- nutrients (cellulose & starch, also dirt & dust)
- temperature (in the range of 0–50 °C)
- moisture (relative humidity of above 60%)
- oxygen

Nath, S.; Dewsbury, M.; Künzel, H.; Watson, P. Mould Growth Risks for a Clay Masonry Veneer External Wall System in a Temperate Climate. Atmosphere 2022, 13, 1755. https://doi.org/10.3390/atmos13111755

2) FUNGUAL DISEASES

Infections caused by pathogenic fungi that can affect various organisms
(**pathogenic** = fungi capable of causing disease, multicellular & unicellular forms)

- pose significant health risks & impact living organisms
- exposure can lead to variety of health issues:

allergies, respiratory issues, skin issues & weakened immune system in humans & animals

classified based on type of fungus and affected body part

any plant part can be affected, e.g. powdery mildew, wilt, root rot, weakened stems

3) CAUSES OF MOULD & FUNGAL DISEASES

Environmental Factors

- **Moisture**: excessive moisture, poor drainage, poor ventilation; irrigation practices like overhead watering leaves the leaves wet
- **Temperature**: warm & humid favor fungal growth,
- **T fluctuations**: stress plants, may promote fungal disease
- **Crop Density:** overcrowded planting > increased humidity & microclimate ideal for fungal diseases
- **Light**: Insufficient sunlight, weaken plants
- **Soil conditions**: overly wet or compacted soils > root rot or other fungal diseases

3) CAUSES OF MOULD & FUNGAL DISEASES

Host Factors

- **Plant Variety**: genetically susceptible (or resistant) to specific fungal diseases
- **Plant Age:** younger plants & seedlings often more susceptible; mature plants often with more robust defense mechanisms
- **Nutrient Deficiency**: deficiencies in essential nutrients (NPK), weak plants more prone to disease
- **Previous Disease**: weakened by previous infection
- **Water Stress:** overwatering or drought leads to stress
- **Contaminated Seeds/Plants:** fungal spore on seed surface or in tissue, infection can affect crop, surrounding soil & water

3) CAUSES OF MOULD & FUNGAL DISEASES

Pesticide/Fungicide Usage

- **Resistance:** overuse > fungal resistant strains, more difficult to control
- **Disrupts Microbial Balance**: kills beneficial microorganisms in soil which help suppress fungal pathogens
- **Plant Stress**: applications can stress plants
- **Residue Accumulation**: high level of pesticide residue can create a conducive environment for fungal growth
- **Nutrient Imbalance**: interference with nutrient uptake in plants
- **Altered Plant Microbiome**: alteration of natural microbiome of plants, reducing presence of beneficial fungi (outcompeting harmful ones)
- **Soil Health Decline:** degrade soil health, reduced ability to support plant growth, increased vulnerability to fungal diseases
- **Fungicide Misuse**: overapplication > shift in fungal populations, more aggressive pathogens thrive

4) IDENTIFYING MOULD & FUNGAL DISEASES

Visual Signs in Plants:

- discoloration (rusty, orange, brown)
- powdery coating of mildew
- curling leaves
- spots of abnormal growth
- stem rot (soft, mushy, discolored, canker)
- roots dark and mushy
- fruits susceptible to mould: white to green velvety patches

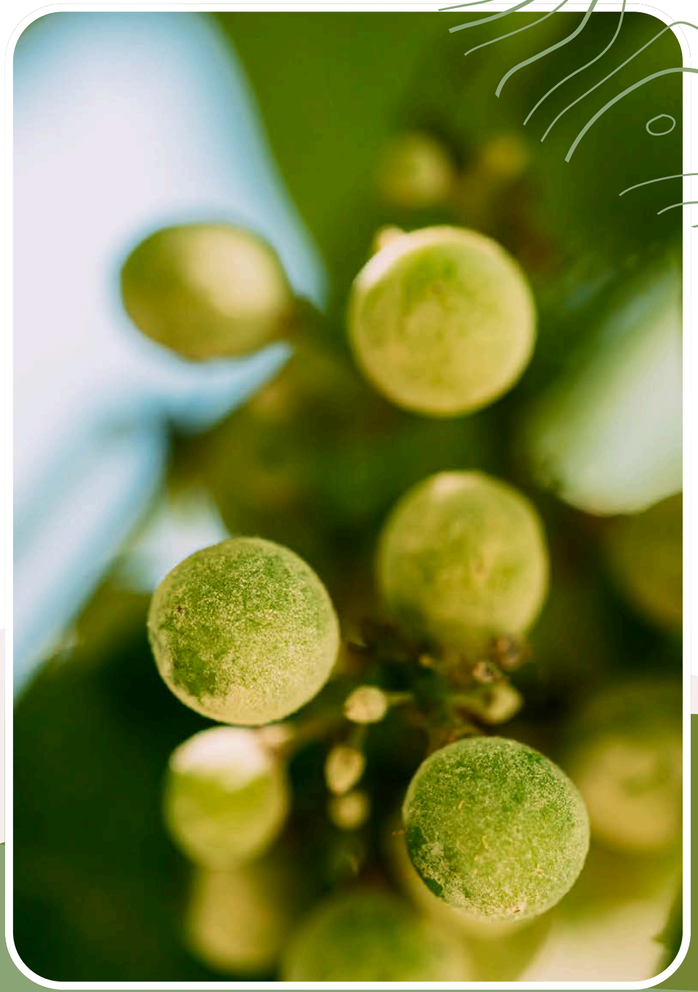
Visual Signs in Animals & Humans

- respiratory issues, coughing, wheezing, shortness of breath
- skin rashes & flaking
- allergic reactions
- regular sicknesses (weakened immune system)
- moldy feed > general weakness, less milk (cattle)

4) IDENTIFYING MOULD & FUNGAL DISEASES

Diagnostic Tools

- leaf sampling
- soil sampling
- laboratory tests
- regular observation
- record keeping
- home testing kits



5. PREVENTITIVE MEASURES

5.1 In-Field

General

- crop rotation
- resistant varieties
- proper spacing (air flow)
- sanitation (clean tools)

Environmental Management

- water & soil management: proper irrigation, avoid overhead watering; proper drainage, aeration & nutrient availability
- mulching: organic mulch to regulate soil T & moisture; reduces infections with soil borne diseases
- timely harvest: minimize risk of post-harvest diseases
- biological control: utilize beneficial microorganisms to outcompete harmful fungi/moulds
- prevent fungi from establishing in soil: remove affected plants/plant parts and dispose (don't compost)

5. PREVENTITIVE MEASURES

5.2 Post Harvest

- harvest crops before they are fully ripe/mature
- high hygiene during and after harvest: sterile/clean tools, buckets, hands; gloves for harvesters
- extended storage time: process/storage/package as soon as possible after harvest, gentle handling to avoid bruising
- minimize field to market/store time
- wash produce lightly without damaging natural coating (wax/oil), pat or air dry quickly
- high hygiene in processing & packing: avoid contamination by using clean packaging and tools, and ensure proper sealing
- in storage: T & humidity control; cool, dry & high airflow (ventilation)

5.2 Post Harvest

- different storage conditions depending on the crop + approximate storage life under optimal conditions

Data Source:

Gast, K.L.B. Storage Conditions. Fruits & Vegetables. Postharvest Management of Commercial Horticultural Crops. Bulletin #4135. (University of Maine) https://extension.umaine.edu/publications/wp-content/uploads/sites/52/2015/04/4135.pdf

Table 1. Commonly grown fruits and vegetables with recommended storage conditions for temperatu and relative humidity, approximate storage life under optimum conditions and highest freezing points

Commodity	Temperature (°F)	Rel. humidity (percent)	Approximate storage life	Freezing point (°F)
FRUITS				
Apples	30–40	90–95	1–12 months	29.3
Apricots	31–32	90–95	1–3 weeks	30.1
Berries				
Blackberries	31–32	90–95	2–3 days	30.5
Currants	31–32	90–95	1–4 weeks	30.2
Elderberries	31–32	90–95	1–2 weeks	—
Gooseberries	31–32	90–95	3–4 weeks	30.0
Raspberries	31–32	90–95	2–3 days	30.0
Strawberries	32	90–95	3–7 days	30.6
Cherries, sour	32	90–95	3–7 days	29.0
Cherries, sweet	30–31	90–95	2–3 weeks	28.8
Grapes, American	31–32	85	2–8 weeks	29.7
Nectarines	31–32	90–95	2–4 weeks	30.4
Peaches	31–32	90–95	2–4 weeks	30.3
Pears	29–31	90–95	2–7 months	29.2
Plums and prunes	31–32	90–95	2–5 weeks	30.5
Quinces	31–32	90	2–3 months	28.4
VEGETABLES				
Artichokes, Jerusalem	31–32	90–95	4–5 months	28.0
Asparagus	32–35	95–100	2–3 weeks	30.9
Beans, dry	40–50	40–50	6–10 months	—
Beans, green or snap	40–45	95	7–10 days	30.7
Beans, lima	37–41	95	5–7 days	31.0
Beans, sprouts	32	95–100	7–9 days	—
Beets, bunched	32	98–100	10–14 days	31.3
Beets, topped	32	98–100	4–6 months	30.3

5.3 HOME SCALE STRATEGIES

- prevent mould on harvested crops: store quickly after harvest, store dry, cool (around 4°C) & vented
- prevent mould on seeds: dry quickly, good air flow (ventilation), spread out thinly, air tight container
- prevent fungi establishing in soil: remove affected plants/plant parts and dispose (don't compost)
- canning: disinfect thoroughly; boil jars & lids
- salting, fermenting, pickling, freezing
- drying fruits, vegetables, herbs: dehydrator or cool, dry & dark place with good air flow,

6. CONCLUSION

Main Idea to prevent MOULD & FUNGAL GROWTH:

Create an environment in which fungi can't thrive.

COOL

T below 10°C

DRY

low moisture level (below 60%)

AIRFLOW

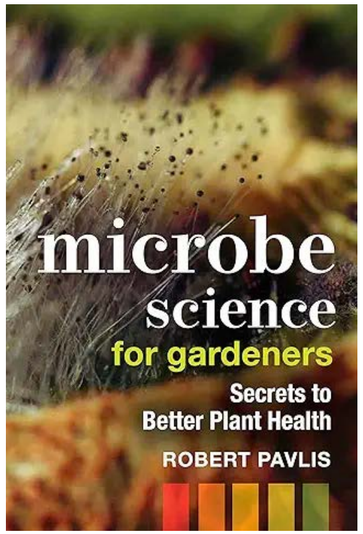
planting, storage

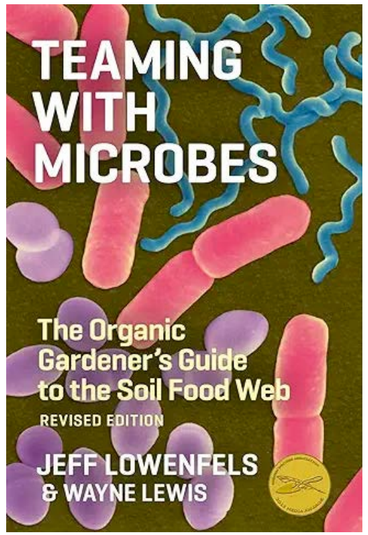
AVOID CONTAMINATION

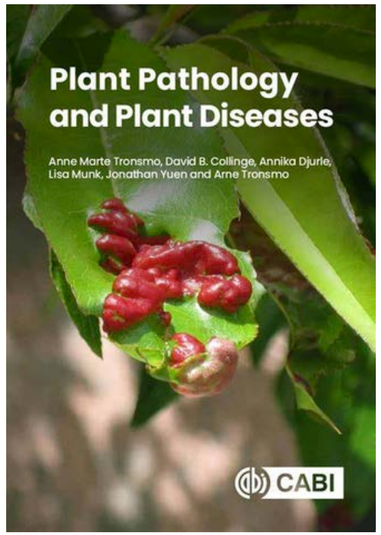
clean/sterile equipment, mulch, packaging

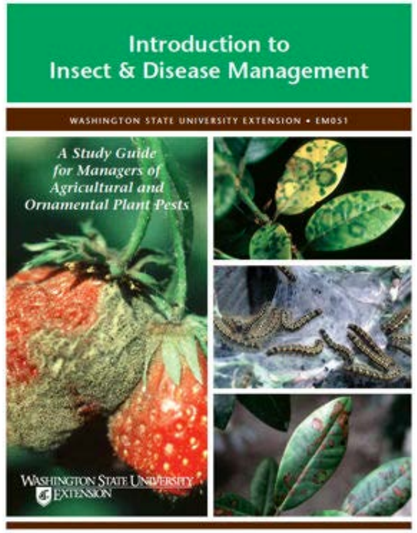
LIMIT TIME HARVEST TO CONSUMPTION

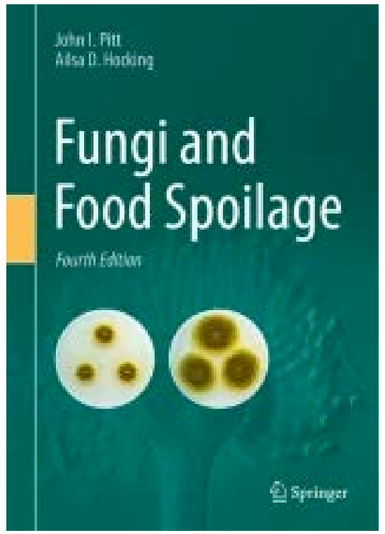
RESOURCES











www.ontario.ca/page/effects-mouldy-feed-and-mycotoxins-cattle

www.fermentedfoodlab.com/tips-to-ferment-vegetables-safely-and-prevent-mold/

Abd El-Baky, Nawal & Amara, Amro. (2021). Recent Approaches towards Control of Fungal Diseases in Plants: An Updated Review. Journal of Fungi. 7. 900. 10.3390/jof7110900.

Cantwell, M.I. and Kasmire, R.F. "Postharvest Handling Systems: Fruit Vegetables." Postharvest Technology of Horticultural Crops, 3rd Edition. Oakland, CA: University of California Agriculture and Natural Resources, 2002. 407-421. Print.

Hardenburg, R.E. Wax and Related Coatings for Horticultural Products: A Bibliography. Series: ARS 51;15. Washington: U.S. Dept. of Agriculture, Agricultural Research Service, 1967. U.S. Department of Agriculture, National Agricultural Library. Web. 30 May 2016.

THANK YOU