ANIMAL HUSBANDRY/MILKING

The ability of animals to contribute to the functionality and efficiency of a farm is outstanding. They provide an incredible food source in milk and meat, quality compostable manure, field and woodlot management, and hours of entertainment and frustration. When deciding the role animals will play on any farm, there are many important factors to take into consideration. These factors include necessary infrastructure, large amounts of time, desired and expected outputs of the animals (meat, milk, manure etc.), and the long-term responsibilities associated with the care of livestock.
Every farmer has a different relationship with herd care and animal treatment. If a farmer or rancher has trouble coercing animals to their job, it is nearly always a failure of human system design, not livestock behavior.

Learning Objectives

The learner will:

- Understand the scope of general concerns involved in raising animals on the farm by learning some of the specific concerns related to animal husbandry.
- Learn and discuss the processes of raising meat and milk animals.
- Be able to describe the basics of ruminant digestion.
- Understand the process of gestation and birthing in common farm animals.

Housing and Bedding Needs

There are two basic types of housing: stalls in which the animals have individual pens and housing where all the animals have a communal living and bedding area. When selecting a style of housing, one must consider the welfare of the animals as well as preserving efficiency for the farmer. Other important considerations include:

- Good ventilation
- Shelter from wind
- Clean, dry bedding
- Accessibility to clean water
- Contamination in free feeders
- Shelter from precipitation
- Manure removal

Feeding and Nutrients

Overview of ruminants:
Ruminants have four chambers of their stomachs known as the rumen. Large numbers of protozoa and digestive bacterium live in the rumen to breakdown protein, starch, fats and cellulose through a process of fermentation. Rumen occupies eighty percent of stomach space in a mature doe.

Proper feed rations:

- Ruminants must have quality roughage such as alfalfa or grass hay.
- Concentrated grain rations are required for milk producers due to heavy protein output – even more so for cheese production .
- Proper mineral intake is extremely important, especially for pregnant and lactating animals.
- The proper feed ration for a milking animal should be 16-17 % protein.
- 12% protein is sufficient for non-milking animals.
- The amount of supplemental feed is directly related to the weight of the animal consuming it.
    - An average cow needs 2.5% of its body weight a day in dry matter. Grass is roughly 85% water and 15% dry matter.
- Free-choice minerals are also important to have available.

Basic Needs and Feeding Systems:

- Feed and feeders should be free of mold and mildew - this is very important.
- Water should be clean and free of phytoplankton (algae caused by sunlight and organic matter) and zooplankton (algae caused by fecal contamination).
- Water kept slightly warmed will encourage increased consumption and therefore benefit overall health.
- Goats should never feed off the ground due to the risk of feed contamination with fecal worm load and unhealthy coccidiosis load.

The Pregnant Cow or Doe

- Average gestation for a goat is about 150 days (5 months), for cows it is 9 months or about 279 days.
- Goats can be bred when they are 60 to 75 percent of their adult body weight, Cows can generally be bred around 18 months of age.
- In goats, twins are common about 65% of the time, but triplets and singles also occur regularly. Quadruplets and quintuplets are rare, but do occur.
- In cows, twins are not common. Mixed gender twins will generally be regarded as sterile.

Signs of approaching birth:

Animals should be checked regularly for signs of birthing for several weeks around expected labor time.

Signs include:

- Hollow flanks
- Discomfort
- Nervousness
- Widening of the space between the pin bones
- Rapid filling of udder

- Mucus flow

Birthing

- Don't freak out! The vast majority of livestock births go unassisted.
- Many different presentations are possible, the normal being front legs first with the nose resting on the hoofs.

Stages of kidding:

- When delivery is coming, colorless discharge will appear, changing to thick and white
- The goat may paw her bedding, lie down and get up restlessly. She may lie stretched out flat pushing with her hind legs against the floor or wall.
- The water bag will appear and in most cases burst revealing legs/nose.
- The doe will generally rest at this point, and then birth with several strong pushes.
- If more are coming, the following kids will be born at varying intervals with no exact time passing between each birth.
- The afterbirth will be passed for each kid and double afterbirth for identical twins.

Post kidding:

- First time mothers often need assistance in helping their kids to stand and begin nursing. Kids sometimes need help cleaning the mucus out of their nose and mouth.

- Kids should begin nursing within the first ten minutes.
- Kids born during cold spells should be dried and encouraged to drink as soon as possible.
- Dip umbilical cord in weak solution of Betadyne to prevent bacteria from traveling up cord.

Complications and remedies:

- If kid is stuck at the shoulders during birth and the goat is exhausted and not making progress, pull down on hoofs away from birth canal.
- If kid is born listless and unresponsive a mixture of colostrum and strong black coffee may be given as well as a vitamin sucrose mixture. This may stimulate body heat and encourage nursing. It is important that the mixture be delivered to the stomach via tube so young kid does not aspirate and asphyxiate.
- Kids born during extreme cold should be warmed up by the assistance of goat keeper.
- It is very important that all kids born are drinking colostrum within a few minutes of being born.

Stages of calving:

- Pre-partum can last from 3 hours to 3 days. The cervix, vagina, and vulva will dilate
- Labor can last 20 mins to 2 hours.
  - Mucus sealing the placenta will give way and the water bag will break. At this point if it takes longer than 30 mins for the front feet to appear at the vulva the animal may be having difficulties.
- Birth starts when the head and shoulders appear
  - Begin assistance here if necessary
- The final stage is the passing of the placenta, which is normally achieved in 12 hours.
  - Do not pull out placenta.
  - Cows may eat placenta to conceal birth from predators.
  - It should be expelled completely in about a week. If not, see your vet.

A few rules for irregular birth in cattle:

- Don't be afraid to call a vet.
- It's better to lose one animal than both.
- You usually CANNOT change a rear-end-first birth to a head-first birth - there isn't enough room to spin the calf around.
- Both front legs MUST come with the head or the front shoulders will not fit.
- No more than two legs through the cervix at once - the calf must be stretched out, not doubled over.
- Before entering an animal to assist, WASH EVERYTHING - your hand, your arm, the shoulder glove if you're using one… Use Lube and go slow. A mild liquid soap, a natural oil, or a personal lubricant are all acceptable.

Raising Offspring

There are many different ways to raise kids; your kid-raising program is dependent on your end goals and your style of management.

- Kids should be fed their mother's colostrum for at least seven days.
- Separate the kids from their mothers after that first week. This will allow you to feed kids based on their individual needs therefore assuring consistent growth.
- The first week kids should be bottle-fed every six hours receiving four to eight ounces per feeding. The second week, twelve ounces eight hours apart. By the third week each kid can receive one quart of milk twice a day. These amounts are all dependent on the size and appetite of the kid, when the kid's stomach is tight the kid is full.
- The kids can have free choice of good hay and water once they are a month old.
- Kids should be weaned when they are two and a half to three times their birth weight. This generally occurs at around two months.

Standard procedure for kids in a dairy goatherd:

- <u>Castration:</u> All males should be castrated as soon as possible or when testicles drop (usually around seven to ten days.) The easiest way is by use of the elastrator, which applies a tight band around testicles and sack to cut off blood flow, and causes sack

and testis to fall off.

- Vaccines: Many goat keepers give their kids injections of essential trace nutrients and or vaccines just following birth but this should be done only after consulting your veterinarian.
- Disbudding: All kids in the dairy herd should be disbudded when appropriate. A dairy herd with horns will cause added expense and labor as adults, due to accidental injury.
    - Disbudding is done using a disbudding iron, when the nubs of horns become evident on the head. The disbudding iron is applied in a circular fashion around the nub until a distinct copper ring appears. Then the top of the nub is scraped off using a hot edge of the disbudding iron. It is important when disbudding for the first time that there is an experienced goat keeper at hand, due to the danger in applying the iron incorrectly.
    - Disbudding can be done with one person and a disbudding box or with several people working together to immobilize the kid.

Milking

Lactating animals should be milked consistently at twelve-hour intervals. Variation of this routine will result in loss of milk production.

Milking equipment used can be as simple or complex as the dairy farmer chooses.

- Milking Stand: The milking stand is a very important piece of equipment for farmer and doe. The milk stand must be comfortable for both human and goat and must provide feeding and confinement for doe.
- Equipment: The milk receiving equipment can be a stainless steel pail or an automatic milking machine. Most farmers will begin with hand milking and graduate to machine milking as needed.
- Stool: Proper stool height is essential to developing good milking posture for the farmer.
- Hand Milking: When hand-milking proper stretching is needed to prevent injury.

Step-by-step milking procedure:

- Bring cow or doe into the milking parlor from the pen or pasture and secure her in the milk stand.
- Provide food as a distraction and a reward for good behavior. This is also when you can tailor to the special dietary needs of each animal if there are any.
- Wash the udder with warm water and sanitize using a weak iodine solution. Use a fresh towel for each goat or cow if you can.
- Dry the udders and pull the first stream of milk from each teat through a strip cup. The strip cup identifies any abnormalities in milk that would be early signs of bad health, such as mastitis.
- Continue milking cow or goat on all teats until she's milked out, taking special care that the udder is completely stripped of milk. Massage or stimulate udders to ensure

thorough milking.
- Dip teats with sanitizer to prevent bacteria from traveling up the milk canal. Release and return her to the herd.

Milk Handling

Good milk handling procedures are essential to producing a high quality, safe and healthy dairy product.

- Strain milk through clean inline milk filters. Cool milk down to 35 degrees Fahrenheit as quickly as possible, ideally within thirty to forty-five minutes of leaving the udder.
- Rinse milking equipment with cold water, followed by warm water and a sanitizing solution.
- Air dry all equipment on a rack, and always store all your equipment upside down.

Diseases and Common Ailments of the Goat

These are only a few of the more common ailments encountered by goat farmers. Most goat husbandry books have a complete list of common goat disease symptoms, causes and cures.

Bloat

- Symptoms –
  - Tightly inflated flanks
  - Extreme discomfort
  - Collapse and eventual death.
- Cause –
  - Overeating of lush wet grass or clover
  - Breaking into food bin
  - Overeating of anything unsuitable or foreign.
- Remedies -
  - Feed eight ounces of vegetable oil for adult or two ounces for kids.
  - Massage flanks. Walk goats around continually until symptoms subside.

CAE (caprine arthritis encephalitis)

- Symptoms –
  - Swollen knees and joints
  - Uneven development of one of the sides of the udder
  - Loss of appetite.
- Cause –
  - Viral infection caused by contagious contact by other CAE positive goats.
- Remedies –
  - Pasteurizing all milk and colostrum fed to kids
  - Blood testing of goats in herd. There is no known cure for CAE.

Hoof Rot

- Symptoms –
    - Lameness in foot or feet
    - Pungent stinking odor in hoof
    - Black soft deterioration of inner ridge of hoof
- Cause –
    - Prolonged exposure to wet ground or pasture
    - Hoof trimming negligence
- Remedies –
    - Regular exercise on dry ground
    - Proper and regular trimming of hoofs.

Internal Parasites

- Goat herd should be on regular worming schedule as advised by local veterinarian in your region.

Mastitis

- Symptoms –
    - Hardening of udder
    - Clotting and blood streaking in milk
    - Fever,
    - Tenderness in udder
- Cause –
    - Bacterial exposure
    - Poor hygienic conditions.
- Remedies –
    - Correct management
    - Overall health
    - Treatable with injectable antibiotics and intra-udder injectable
    - Old-timers will tell you to milk her out every few hours, to try to rid the bacteria from the udder. This is an acceptable method only if it's a mild case or you catch it early. Don't keep the milk, and monitor the animal closely.

Lice

- Symptoms –
    - Weakness
    - Anemia
    - Listlessness in kids
    - Emaciation
- Cause –
    - Exposure to domesticated fowl
    - Poor living conditions.

- Remedies –
    - Topical and/or injected parasite controls designed specially for lice.

Assessment and Review

- Describe the basics of ruminant digestion.
- Describe the signs of impending birth and the stages of birthing.
- Discuss a few rules for calving.
- Discuss basic milking procedure.
- Name a common ailment of the goat, describe symptoms and suggest a remedy.

NOTES

BIODYNAMICS

Turn to the ancient principle:
"Spirit never without matter, matter never without spirit!"
And say to yourselves:
We will do everything material in the light of the spirit,
and we will seek the light of the spirit in such a way
that it enkindles warmth in us for our practical deeds.

Biodynamics is not so much a method of farming as it is the training of a farmer to more fully perceive what is happening on his/her farm and how to respond to that perception. It is based on a grander rhythm and a holistic set of principles that goes beyond organics to include considerations of the cosmos, ancient traditions and interacting with your farm as a complete organism. The farmer is the will of the organism, and ultimately the priest.

Learning Objectives
The learner will:

- Understand the basics of biodynamics, including the history, the approach, and the preparations.
- Learn about perceptions of biodynamic farming

Historical Backdrop

- Justus Von Liebig (1803-73) "father of Ag. Chemistry" – discovered the importance of N,P&K
- WWI brought NO3 fertilizer made from bomb making surplus - tanks became tractors, poison nerve gas became insecticides and herbicides
- Sir Albert Howard (1873-1947) – soil=plant health, farm-scale composting process
- Lady Eve Balfour (1898-1990) - The Living Soil (1943), founded the Soil Association (UK) and Mother Earth Magazine.

Rudolf Steiner (1861-1925) from rural Austria, studied in Vienna

- Found modern science only understands what is dead in nature, overlooks the spiritual aspect of reality, thus introduced Anthroposophy and spiritual science
- Led initiatives in education, health, care of mentally handicapped, architecture, theology, agriculture, economics and other fields
- Farmers came to Steiner with questions, finding their yields dropping and an increase in disease. He suggested a farming approach with more spiritual grounding and a more holistic awareness of the farm organism.
- From this rose the "Experimental Circle" of farmers to implement these ideas and evaluate. By 1928 there were 66 Biodynamic farms.
- During WWII both Anthroposophy and biodynamics were banned by the Nazi leadership
- Biodynamic is now widespread in Europe, Australia, NZ, India and to a lesser extent in US and Canada

The Biodynamic Approach

- A holistic background is necessary to understand the complexity of the natural world.
- Become a student of nature: Mind –rational/philosophical, Spirit-emotional, Tactile-experience of plants, animal, minerals, weather
- Understand the farm as an organism, plant and animal health are tied to the health of the land and soil.
- Read the book of nature – pests & disease are a result of imbalance in the soil
- Biodynamics aims to enhance the biological process through stimulating microbiological activity in soil and compost
- Organic is a common sense approach: "nature knows best" (beneficial insects, compost, garlic and pepper sprays)
- Biodynamics includes a much wider scope: sun, moon, planets, biology, subterranean features, and a deeper look into the spirit of nature.
  - Aiding nature where she is weak after centuries of abuse and destructive processes
  - Letting things run their natural course (when we harvest lettuce before it goes to seed, we interrupt many natural processes, e.g. Field to forest succession)
  - Service to Earth and its creatures: diverse plantings, hedgerows, bird & bat houses, bee pastures, closed loop systems, using natural rather than technological solutions (permaculture)
  - Healthy soils are the foundation of a healthy and productive farm, compost is a key component of soil health.
  - Fighting bugs and disease are not aims, rather support the good and health and balance will result
  - The problem is the solution.

Perceptions to develop include:

- **A macrocosmic perspective**
  - Cosmic rhythm
    - Solar – daily, annual
    - Lunar rhythms; apogee vs. perigee, ascending, & descending phases, eclipses
      - Perigee brings forces that result in poor germination, inhibited growth, fungus, disease, pests (dull, heavy rainy weather)
      - Apogee – clear and bright weather – generally not good planting time other than potatoes
    - Zodiac
    - Humans are 85% water

- **All form or substance is the carrier of forces**
  - What are these forces?
    - Calcium – associated with the inner planets Moon, Venus, and Mercury
      - Soil life and water
      - Yield and protein content

        - Repetitive growth
        - Fleshy, wet
        - In-breath, sucking into itself and thereby bulking up
        - Radial movement from a point outward
        - Too strong=luxuriant growth, susceptible to disease and pests, poor keeping qualities
    - Silica – associated with the outer planets Mars, Jupiter, and Saturn
        - Light and warmth
        - Maturation or ripening, keeping quality, seed quality, nutritive quality, taste
        - Creates form and definition
        - Dry
        - Outbreath, selfless and giving
        - Periphery moving toward an infinite point
        - 501
        - Too strong=low yields, bitter flavor, fibrous woody texture
- Clay – mediates between silica and calcium
    - Carrier of life

Common Biodynamic Preparations

- Field Sprays: 500 –Horn Manure –supports soil humification, microbial innoculant
- 501 - Horn Silica – organizes photosynthesis – works with light elementals
- Compost Preparations
- 502 – Yarrow – Sulfur (S) and potassium (K)
- 503 - Chamomille – Calicium (Ca), Sulfur (S), Nitrogen (N)
- 504 – Nettles – S, K, Ca, Iron (Fe) – plant nutrition and soil health
- 505 – Oak bark – Ca – combats plant disease by strengthening cell wall - Calcium forces
- 506 – Dandelion – K & Silica (Si) – Silica attracts cosmic forces to the soil
- 507 – Valerian – Phosphorus (P) – warmth process and attracts earthworms
- 508 – Horsetail – Silica (Si) – fights fungal conditions, good in Greenhouse

Assessment and Review

- Describe how Rudolph Steiner and biodynamics came to be
- Discuss a few key components of the biodynamic farming approach
- Discuss how biodynamics views the role of the farmer

NOTES

BUSINESS 101

Plenty of good farmers are losing money without knowing it, or are driven out of farming altogether by an inability to keep up with their books, financial statements and day-to-day documentation. Understanding the vocabulary and requirements of good bookkeeping can be daunting, but it is surely one of the most important pieces of a sustainable farm model.

Learning Objectives

The learner will:

- Get to know the different financial documents essential to running a small business
- Think about business planning and the different components of a successful model
- Understand enterprise budgeting
- Discuss ways to track your business in real time

Challenges of running a successful farm business

- Finding affordable land
- Achieving a scale of production that works
- Finding scale-appropriate tools and machinery
- Finding and managing employees
- Balancing family, personal time, business, etc.

Tips for success!

- Take care of your SOIL!
- Use season extension to increase gross sales
- Focus on quality and set your prices accordingly
- Avoid commodity crops
- Keep good records
- Limit investment in equipment- choose carefully!
- Develop a good marketing plan
- If you have employees, invest in communication and management
- Try to keep expenses low
- Learn from others!

Components of a Business Plan

- Executive Summary
- Management Plan
- Land Management
- Risk Assessment
- Products
- Capital Investments
- Markets
- Marketing Plan
- Budget

Important Financial Statements

- Cash Flow Statement
  - Shows month-by-month flow of cash.
  - Usually on a farm, there is a greater cash out in the spring and more cash in during the summer and fall.
- Income Statement
  - Shows how much money farm generated over a year, and what expenses were
- Balance Sheet
  - Provides an overall picture of the farm business.
  - What are the assets of the farm?
  - What are the liabilities (debt) that farm owes?

Enterprise Budgeting

With multiple crops on your farm, how do you determine which ones are profitable?

- Good Growing Criteria
  - Grow crops that thrive and are marketable
  - Benchmark per 100 ft bed or acre
  - Use variable costs

- Components to an Enterprise Budget
  - Income/Returns, based on
    - Quantity and units
    - Yields
    - Prices
    - Historical production and/or records
  - Outflow/Expenses
    - Variable Costs
      - Costs that change according to the volume of production
      - They are usually grouped into stages of production, e.g. Production operation, harrow, disk, seed, etc.
      - They are divided between Cash Cost (Fuel, Twine, repairs) and Non Cash Cost (Owner labor)
    - Fixed Costs
      - Costs that are incurred whether production of the enterprise occurs or not once the land machinery and equipment necessary have been obtained. Often referred to as "ownership costs"
      - Cash
        - Mortgage
        - Equipment
        - Land Leases
      - Non-Cash
        - Depreciation of Equipment

- Challenges to Enterprise Budgeting
  - Tracking labor

- Variations in yield (year-to-year, or across multiple locations)
- Doesn't take into account crop rotation, limiting factors, soil health, etc.

Tools for Small Farm Businesses

Financial recordkeeping:
Quicken or Quickbooks
http://agecon.okstate.edu/faculty/publications/3880.pdf

Payroll Programs:
Intuit, Payroll Program, Sage

Writing a Business Plan:
Building a Sustainable Business
http://www.misa.umn.edu/Publications/BuildingaSustainableBusiness/

OSU Extension Small Farms - Growing Farms Workshop Series

Other Resources
Cornell University- Profitability Tutorial:
http://www.nebeginningfarmers.org/farmers/achieving-profitability

The Organic Farmer's Business Handbook by Richard Wiswall
Farmertofarmerpodcast.com - Chris Blanchard

Assessment/Review
- Describe the three most important financial documents for a small business
- Discuss components of a solid business plan
- Define enterprise budgeting and why it's important

NOTES

COMPOSTING

An efficient and active compost system on a farm is a vital resource, turning by-product or waste product into important soil-supporting material. Composting breaks down organic matter into humus, which when added to soil improves tilth, fertility and biological activity. With a very basic understanding of this living mass, any individual can be successful at composting, having lasting effects on the health of your soil ecosystem.

Learning Objectives

The learner will:

- Understand the various roles of compost on a farm
- Have a basic understanding of the processes involved in decomposition
- Learn how to make a good compost pile and proper application methods

Compost

- Compost is the action and end result of decomposing organic materials in their raw form, creating an important soil amendment that improves the soil fertility and tilth.
- Compost can be produced with nearly any form of organic material, including plant matter, manure, bedding, yard waste, kitchen scraps, and even meat and feathers if done safely.

Roles of Compost on a Farm

- Recycled waste material on site, reducing your waste stream
- Adds large amounts of humus to soil
- Increases soil fertility and stabilizes nutrients such as nitrogen
- Greatly increases biological activity in soil
- Improves soil structure and ability to retain water
- Creates outlet for potentially harmful excess of raw manure

Decomposition

There are 2 types of decomposition:

1. Aerobic decomposition is the breakdown of raw materials in which oxygen is present. This is the type of decomposition that is relevant for composting.
2. Anaerobic decomposition is the breakdown of raw materials in the absence of oxygen and can be identified by a distinctly foul ammonia-like smell and a generally "slimy" feel.

Organisms involved in Aerobic Decomposition

Bacteria

- Breakdown of carbonaceous material
- Heat pile by CO_2 respiration

Fungi

- Breaks down more complex structures like cellulose
- Breaks down woody particulates in compost pile
- Binds soil together, improving overall structure

Macro-organisms

- These organisms include earthworms, beneficial nematodes, fermentation mites, springtails & more
- Most macro-organisms feed on earlier inhabitants of the compost pile, supporting the food chain inside the pile.
- They produce castings, which contribute to the fertility of the soil.
- They aerate the compost mix, which introduces more oxygen, which in turn helps the pile finish faster and decompose more thoroughly.

Components of a Good Compost Pile

- Carbon to nitrogen (C:N) ratio is important to the health of pile. Initial ratio should be approximately 25:1 by weight. Carbon-rich materials tend to be browner, drier, deader, and less stinky. Nitrogen-rich materials tend to be greener, wetter, smellier and more alive.
- Moisture in pile should be equivalent to a rung-out sponge. A good rule of thumb should be the fist crumble test. One should be able to grab a fist full of compost and squeeze it into a ball that holds its form but crumbles under slight pressure.
- Dimensions of the pile are important. Minimum size is 3'x3'x3'. Optimal size is 6'x6'x6'. This creates conditions that are most manageable and appropriate for a hot compost pile. Windrow piles can be as long as you want.
- Check your compost twice a week:

  Temperature: Optimal temperature should be between 130°F to 150°F. Anything over 150°F can begin to kill beneficial microbes. Certified Organic compost has very specific temperature requirements to ensure any potential pathogens are killed.

  Smell: Ammonia (N being lost), stink (anaerobic), actinomycetes

  Visual: Ashing (too dry and hot), oozing liquid (leachate) at base of pile (too wet or too much N)

  Feel: Too moist or too dry?
- The compost pile should be covered in most conditions. This will prevent excess water from leaching out good nutrients and having potentially negative runoff. It will also retain moisture better when it's hot and dry, so you'll have less need to water the pile.
- The compost pile should be turned regularly using any means available. Turning the pile redistributes heat, biological activity, C:N ratio, and moisture content, it also helps it finish much faster.
  - There's no specific way to do this. As long as things get mixed around, you're doing it right.

Application of Compost

- Five to seven tons of compost per acre is a generally acceptable rate of application for field dispersal, but it all depends on your soil needs.
- Intensive garden situations may need up to 10 tons per acre.
- When developing a new garden or field, compost should be integrated into the top 18 inches of soil.
- For a developed field, compost integration should be no deeper than eight inches.
- Compost should be applied in the spring prior to planting, midseason as an amendment side dress, and in fall prior to cover cropping.
- Compost Tea is an application involving soaking and aerating a mix of water and compost for a day or two, then spraying it on your plants.

Other types of compost

- Vermiculture – limited in what you can add, smaller scale, very rich product
- Fungal dominant compost – wood product, little or no turning (Hugelkultur)

Assessment/Review

- Name several roles of compost on the farm.
- What types of organisms help the decomposition process?
- What are some important keys to maintaining a healthy compost pile?
- Why is it important to turn a compost pile on a regular basis?

NOTES

CONSERVATION & ECOLOGICAL AGRICULTURE

Learning Objectives

The learner will:

- Learn about various approaches to conservation farming and see examples
- Understand ecological processes underlying ecological farming approaches
- Understand attributes of natural systems farming, agroforestry systems, and wild farming approaches

Goal of Conservation Farming = protect natural resources for:

- Current and future producers
- Wildlife
- Natural cycles and processes
- Intrinsic value
- Save $$$ (less inputs needed)

How do we as farmers protect natural resources?

- Mimic natural processes
- Reduce footprint / impacts
- Good stewardship

Conservation farming = design and application of appropriate farm systems & programs.

Farm Conservation Topics

- *Water* — Irrigation, waste, stormwater, runoff
- *Soil Health* — erosion, fertility, structure, permeability, biotic activity, rotations
- *Energy* — equipment, carbon footprint, infrastructure, transport
- *Biodiversity* — habitat, pesticides, tillage practices
- *Livestock Management* — pasture/grazing management, riparian protection
- *Farmer Conservation* — stress management, farmer health, work-life balance, efficiencies

For future pondering: How does the farm you work on—or plan to manage someday—interface with all these facets? Can you detail them in a plan?

Ecological Processes in Healthy Agroecosystems

- Nutrient Cycling (deeper, balanced cycles)
- Hydrology (enhanced infiltration, soil moisture storage)
- Energetics (enhanced capture of solar and water inputs)
- Soil Conservation and Building
- Predator – Prey Relationships (beneficial insects, birds and mammals for pest control)
- Disturbance (herbivory, resilience to extreme events, weather, etc.)

Ecological Farming Systems

- Farming in Nature's Image: seeking to mimic natural systems
  - Permaculture (system of design can be applied to agriculture)
    - Forest Gardens, Food Forests
  - Natural Systems Farming: Land Institute & Perennial Polyculture
  - Rotational/Mixed Species Grazing Systems (Savory & others)
  - Agroforestry: growing herbaceous crops and trees together
    - Windbreaks/hedgerows
    - Live fences
    - Alley cropping
    - Field/Pasture Trees (Acacia albida, Oregon white oak)
    - Taungya
  - Agroforestry System Attributes
    - Deep nutrient cycling
    - Enhanced wildlife/livestock habitat
    - Increased biotic diversity
    - Increased crop diversity
  - Silvopastorialism: raising livestock and tree crops together
  - Agrosilvopastorialism: livestock, crops and trees
- Incorporating Natural Areas on the Farm:
  - Riparian Areas
  - Woodlands
  - Hedgerows
  - Beetle Banks
  - Field Margins
- Biodiversity Within Actively Farmed Area:
  - Cover Crops
  - Intercropping
  - Strip Cropping
  - Insectaries & Pest Strips
  - Low or no till
  - Alternate Mowing
  - **Note: More info on "Farmscaping for Beneficial Insects in Entomology outline

Conservation Tillage

- Tillage is the process of preparing land for planting.
- Problems that arise from some types of tillage or over-tillage:
  - Compaction/hardpan
  - Reduced permeability
  - Reduced soil biodiversity
  - Mixing horizons/destroying soil structure
  - Increased wind and rain erosion
  - Propagation of problem weeds (especially perennials)

- Rototilling alternatives:
  - No till — Heavy duty seed drill that can plant directly into soil or a cover crop mulch without tillage (only practical with grains and legumes)
  - Discs — cuts and folds the soil to incorporate vegetation (primary tillage only; no hardpan created)
  - Spader — turns topsoil to create finished seedbed without creating hardpan
  - Perfecta II/till an' bedder — combination of s-tines, roller, and spike harrow to create a finished seedbed (secondary tillage only)
  - Hand tillage — forks, broadforks, shovels to turn soil (e.g., double-digging)
  - Tillage radish — use diakons in cold climates as a means for loosening up compaction and incorporating organic matter (not really primary or secondary tillage, but aids final seedbed quality)

Resources:

- Natural Resource Conservation Service can offer technical assistance and has local offices everywhere.
- Imhoff, Daniel. 2003. Farming With the Wild: Enhancing Biodiversity on Farms and Ranches.
- Jackson, Dana, and Laura Jackson. 2002. The Farm as Natural Habitat: Reconnecting Food
- Soule, J. and J. Piper. 1993. Farming in Nature's Image: An Ecological Approach to Agriculture.
- Wild Farm Alliance: www.wildfarmalliance.org
- Association for Temperate Agroforestry - www.aftaweb.org

Assessment/Review

- How would you mimic a prairie in an agroecosystem? A forest?
- Describe the ecological processes functioning in an agroforestry system.
- Why is biodiversity important on a farm?
- Describe wildlife-friendly elements in a farming system.
- What are some problems that can arise from tillage? What are some alternatives?

NOTES

COVER CROPS

Learning Objectives

The learner will:

- Be introduced to various types of cover crops and their specific applications.
- Be able to identify various benefits of cover crop application.

Why Use Cover Crops?

Cover crops are one of the primary fertility and soil management tools available to the organic farmer, and are an important strategy for preventing nutrient and soil loss from a field. They are crops grown primarily for soil or ecosystem improvement rather than cash and can provide a variety of services, from increased nitrogen (N) input, to soil protection, to weed and disease suppression. However, they can also have negative consequences if they are managed incorrectly or the wrong species are chosen.

Types of crop:

- Cover crop: Mainly used to prevent soil erosion by covering soil with living plants
- Green manure: Crop grown mainly to be turned under for soil improvement
- Catch crop: Used to "catch" nutrients left after harvest of a cash crop and prevent leaching out of the field

These are not mutually exclusive functions. For example, a fall-planted cereal + legume crop that is incorporated the following spring can serve as a cover crop, green manure, and catch crop. However, different species and mixes may perform one function better than another.

Perennial Cover Crops

- Perennial cover crops are most often planted in pastures and orchards.
- Often perennial cover crops require irrigation.
- Perennial cover crops have multiple purposes and benefits:
  - Providing forage
  - Holding soil/preventing runoff and erosion
  - Retaining moisture in soil/drought tolerance
  - Fixing nutrients through root system
  - Preventing leaching of nutrients from runoff
  - Smothering weeds
  - Cycling nutrients up from subsoil
  - Penetrating hard subsoil
  - Improving soil structure

Self-Seeding Annual Cover Crops

- Self-seeding annual cover crops are most often planted in fallow fields and orchards.
- Often annual cover crops do not need to be irrigated.
- Annual cover crops have similar purposes and benefits as the list above. But the seed

cycle makes it an ideal option for western climates with a dry summer.

Green Manure

- Green manure is a term for an annual crop sown for the purpose of incorporating back into the soil. The green manure crop can be fall, spring, or summer sown, and irrigated or dry.
- Green manure has benefits similar to those of other cover crops, but when the crop is incorporated into the soil the following additional benefits are realized:
  - Trapping nutrients (nitrogen, phosphorus) in the soil that were fixed from atmosphere via root systems
  - Adding tons of carbon (organic matter) to the soil. This builds humus, a biological soil network that is the key to unlocking nutrients in the soil. (Addition of organic matter is also beneficial to soil structure, water holding capacity, air circulation, and friability.)

Steps to Choose a Cover Crop

1) Identify what you want the cover crop to do:
   - Provide nitrogen
   - Increase soil organic matter (SOM) and improve nutrient availability by increasing soil biological activity
   - Scavenge nutrients left in the soil after the cash crop and prevent loss by leaching
   - Prevent soil erosion
   - Improve soil structure
   - Improve drainage
   - Protect water quality
   - Provide mulch to conserve soil moisture
   - Provide habitat for beneficial insects and spiders
   - Suppress weeds
   - Suppress soil borne pests and diseases
2) Identify the cover crop planting niche
   - Define timing of critical field operations for cash crop production
   - Winter cover crops
   - Summer cover crops
3) Select cover crop species or mix to meet the goals and requirements from steps 1 and 2

Examples - Field Activity

Tour various cover crops, identify components (nutrient fixing plants, scaffold plants, carbon source plants), and dig holes to expose soil profile. Examples used in Oregon may include:

- Perennial - alfalfa, some clovers, rye, fescue, orchard grass, birdsfoot trefoil
- Self-seeding annual - rose clovers, sub-clovers, medic, rye
- Green manure:

- Cold weather - peas, oats, fava beans, vetch (vulnerable at seedling below 20 F), rye, triticale
- Warm weather - buckwheat, black-eyed peas, cow peas, sudan grass

External Resources:
-Cover Crop Resources are available in your Resource Guide.
-OSU has some excellent charts and publications for the Northwest, including a calculator showing how much you need to do based on your soil type and crop regime.

Assessment/Review
- What are the three basic types of cover crops?
- What are the specific benefits of each type of cover crop application?

NOTES

CROP ROTATION

Learning Objectives

The learner will:

- Understand various benefits of a system of crop rotation.
- Examine two popular rotational designs.

Crop Rotation Overview

- Crop rotation is the practice of growing a wide variety of crops in a sequential system throughout the field with the intention of avoiding a buildup of disease and pests associated with monocropping.
- Crop rotation also promotes good soil health by alternating crops with different nutrient needs, therefore avoiding depletion of any one necessary element present in the soil.
- Crop rotation can also benefit overall soil structure by alternating deep and shallow rooting plants, breaking up subsoil and reducing the effects of plow pan.
- The practice of crop rotation is ancient in its use, and is widely recognized as a cornerstone of good agricultural practice.

Importance of Legumes in Crop Rotation

- Legumes are plants in the family Fabaceae and are described as nitrogen fixing plants. Legumes collect nitrogen from the air and fix it on the root systems in the form of nodules.
- Legumes are a great crop to alternate with heavier feeding plants such as corn. The legumes return nitrogen to the soil after the plant is harvested or dies back.
- Legumes fix nitrogen through a symbiotic relationship with bacteria known as rhizobia that is naturally occurring in soil but often introduced in the form of an inoculant by the farmer planting the legume.
- Two types of legumes that are farmed are forages and grain. Common forages are: alfalfa, vetch, and clovers. Common grains are: Beans, lentils and peas.

Benefits of Crop Rotation

- Crop rotation can increase yields by15-20% when compared to monoculture.
- Increases the overall biomass of the soil
- Improves weed suppression by maintaining better soil health and providing living leguminous mulches.
- Provides valuable fodder for livestock while enriching the soil.

Popular Rotational Designs

- *The Corn Belt system on large farms:* Apply manure, grow corn, follow with soybeans, apply manure, grow corn, and follow with several plantings of alfalfa. In this rotation, legumes fix nitrogen in the soil before the heavy feeder crop (corn, in this example.) Specific plant pest cycles are interrupted. Specific plant disease is similarly suppressed. In this crop rotation, alfalfa cultivation also serves to smother weeds. Manure is applied before the heaviest feeder. Livestock feed is grown for use on farm

or for sale.

- *Intensive vegetable rotational system:* This eight year rotational cycle can be adapted to many growing regions. Sweet corn followed by tubers followed by squash, followed by root crops then beans followed by tomatoes, followed by peas then Brassicas. This style has been most recently made popular by Eliot Coleman and is benefited by the following relationships.

  - **Potatoes** follow sweet corn…because research has shown corn to be one of the preceding crops that most benefit the yield of potatoes.

  - **Sweet Corn** follows the cabbage family because, in contrast to many other crops, corn shows no yield decline when following a crop of brassicas. Secondly, the cabbage family can be undersown to a leguminous green manure which, when turned under the following spring, provides the most ideal growing conditions for sweet corn.

  - **The Cabbage Family** follows peas because the pea crop is finished and the ground is cleared [early] allowing a vigorous green manure crop to be established.

  - **Peas** follow tomatoes because they need an early seedbed, and tomatoes can be undersown to a non-winter-hardy green manure crop that provides soil protection over winter with no decomposition and regrowth problems in the spring

  - **Tomatoes** follow beans in the rotation because this places them 4 years away from their close cousin, the potato.

  - **Beans** follow root crops because they are not known to be subject to the detrimental effect that certain root crops such as carrots and beets may exert in the following year.

  - **Root Crops** follow squash (and potatoes) because those two are good cleaning crops (they can be kept weed-free relatively easily), thus there are fewer weeds to contend with in the root crops, which are among the most difficult to keep cleanly cultivated. Second, squash has been shown to be a beneficial preceding crop for roots.

  - **Squash** is grown after potatoes in order to have the two cleaning crops back to back prior to the root crops, thus reducing weed problems in the root crops

Designing your own Crop Rotation system

- Based on your scale and soil needs, decide how many years your rotation can be**,** keeping in mind you don't have to fill every space every part of the year.
- Break up your farm into as many blocks on paper and fill in what you grew there last year, or what you have planted currently.

- Based on the nutrient needs of your different crop families, and the crops that see the greatest pest pressure, draw out on a separate sheet of paper where you might plant your crops next year.
- Continue this mapping until you have created a cyclical plan that brings you back to where you are now, but with stronger soil, better planning, and higher quality produce.

Assessment/Review

- Why is it important to have a solid understanding of characteristics of specific crops and the relationships between specific crops in order to design an effective crop rotation system?
- What is the importance of legumes in a rotational cycle of planting?
- Besides general soil/plant health, what are some specific benefits to rotating crops?
- How might you design your own crop rotation system?

NOTES

ENTOMOLOGY & INTEGRATED PEST MANAGEMENT

Learning Objectives
The learner will:

- Gain a basic understanding of the balance of insects on the farm/garden (pests and beneficial insects.)
- Be able to identify a number of common pests and suggest methods of control.
- Be able to identify several beneficial insects and discuss how they interact with crops and insect pests.

Basics of IPM and farmscaping (enhancing landscape feature on your farm to promote beneficial organisms)

- Correctly identify pests (animal, environmental, disease)
- An ecological, whole farm systems approach
- Understand the biology and ecology of the pest and beneficials associate with it
- What system imbalances contribute to it the pest and why is it occurring
- Decide management options you will use (IPM/CBC/farmscaping)

Integrated Pest Management

What is IPM?
IPM is a broad ecological approach to pest management utilizing a variety of pest control techniques that target the entire pest complex of a crop ecosystem. The formalized concept of IPM has been around for only three decades.
Four step approach (PAMS), starting with the first, using the last only when you must:

- *Prevention* — Prevent introduction to the farm, hot spots, spread between fields
- *Avoidance* — Avoid pest susceptible crops or practices that increase losses
- *Monitoring* — Monitor and identify pests, manage sites of high pest risk and use decision-support tools
- *Suppression* — A) physical, B) cultural or biological, C) chemical methods of suppressing pests

PAMS

1. *Prevent* introduction into the farm/field:
    - Certified seeds or hot water seed treatment
    - Build habitat for beneficials and predators
    - Healthy transplants
    - Make sure compost is hot enough to kill weeds and diseases
    - Clean equipment after use
    - Don't have exposed potato cull piles
2. *Avoid* susceptible crops or practices:
    - Resistant or tolerant varieties
    - Nutrient deficiencies or excess
    - Deficient or excessive irrigation
    - Compaction or poor soil health

- Poor crop rotation

3. *Monitor* and ID pests & use decision-support tools:
   - Walk your fields
   - Check hot spots (field edges, last year's problem areas, etc.)
   - Look under leaves and in leaf axils
   - Use a hand lens
   - Keep field notes
   - Talk to experienced farmers
   - Send in samples for analysis at OSU Plant Clinic ($75)
4. *Suppression* (least toxic and less impacting first):
   • Physical barriers
   - Floating row cover / Insect netting
   - Surround (kaolin clay)

   • Cultural & biological
   - bT (*Bacillus thuringiensis*)
   - Nematodes

   • Chemical
   - Soap or pepper sprays
   - Pyganic (pyrethrum)

Farmscaping for Beneficial Insects & Pest Management
Planning and implementation of practices to increase habitat for beneficial organisms of the farm.

- Functional Agricultural Biodiversity
  - The positive benefits to a farming system that result from on-farm biodiversity (at genetic, soil, and organism level). Many of these benefits are ecosystems services such as increased diversity of beneficial soil microbes, sustaining and increasing diverse plant genetics for crops and non-crop vegetation.
- On-farm biodiversity can:
  - Mitigate the effects of pesticide drift
  - Reduce soil erosion
  - Decrease dust, weed seed migration, successfully compete with invasive spp.
  - Increase water quality
  - Increases organic matter in soil which fosters microbial diversity and reduces contamination risks
  - Increase crop pollination
  - Provide food and shelter for beneficial insects which can aid in pest management and decrease pesticide use
- Insectary plantings — species that will attract beneficial insects (pollinators, predatory)
  - Brassicascea (sweet alyssum)
  - Umble (coriander)
  - Compositae (sunflower, calendula)
  - Legumes (crimson clover)
  - Others (phacelia, buckwheat)

- Beetle Bank — raised section or earth that mimics upland habitat and is ideal for ground-dwelling and nesting insects.
- Hedgerows — habitat and forage for birds and insects
- Cover Crops — short-term habitat that can provide forage (leave some to flower and or seed)
- Trap Crops — in-field plantings that draw pests away from your primary crop (examples: blue hubbard squash, mizuna, bok choy)
    - Plant trap crop 2 – 4 weeks before main crop
    - Perimeter vs. Strip trap crop
    - Light green crops (e.g., arugula, radish greens) attract flea beetles, dark green, waxy crops (e.g., collards) attract aphids
    - Treat trap crop with insecticide or DE

HARMFUL PESTS

Corn Earworm

- Range: From the lower half of Canada stretching to the extreme southern latitudes of southern America
- Host plants: Mostly corn and tomatoes. Occasionally found on some bean varieties.
- Appearance/Habits: Winters in soil as pupa. Brownish green moth emerges in spring. The moth then lays several thousand eggs on hosts. Several generations are possible in a season. Larvae burrow into cob through silk leaving tunnel of excrement in path.
- Control: Planting marigold near corn is helpful. Mineral oil applied to browning silk at tip of ear is helpful. (one dropper per plant maximum)

Squash Bugs

- Range: Common throughout the US from Central America to Canada.
- Host Plants: Squash bugs attack all vining plants, congregating enthusiastically on squash and pumpkins.
- Appearance/Habits: Dark brown, sometimes light spotted brown. Hard shell. Three to four inches long. There are five nymph stages before the adults appear in eight weeks. Leaves eaten by squash bugs begin to wilt, blacken, and die. Smaller week plants may be have 40 percent die off rate.
- Control: Companion planting with radishes, nasturtiums and marigolds is beneficial.
- Striped/Spotted Cucumber Beetle
- Range: Native to United States and from Mexico to Canada.
- Host Plants: The striped cucumber beetle is a voracious pest of all the members of the cucurbit family. The spotted cucumber beetle is a much more general feeder effecting up to 250 different vegetables, flowers, weeds and grasses.
- Appearance/Habits: Striped cucumber beetle: Yellow beetle with three black stripes down back. Spotted cucumber beetle: Greenish yellow back with twelve pronounced black spots. Cucumber beetles affect the garden host plants in numerous harmful ways. They feed on all portions of the host. They can carry cucumber wilt as well as mosaic virus.

- Control: Protect transplanted starts with Remay. Straw mulch can slow spread of adults considerably. Predators of cucumber beetles include braconid wasps, nematodes, and soldier beetles.

Cabbage Worm

- Range: Imported worm/moth arrived on this continent in the late 1800's and can be found throughout the US.
- Host Plant: Specializes in members of the cabbage and mustard family but can also be found in other brassicas and some lettuce.
- Appearance/Habits: Springtime when temperature becomes warm enough pupa hatch into white butterfly with three or four black spots on their wings. Butterflies lay yellow oval shaped eggs hatching into soft green caterpillars. Caterpillars eat large uneven holes in foliage. They feed for roughly three weeks and pupate. There can be as many as five generations in a season.
- Control: Companion plant with tomatoes, onion, garlic, and other alliums. Remay can be effective if used early on in the season. Encourage Braconid wasps by planting strawberries near possible host plants or around gardens.

Aphids

- Range: There are many different species of aphids that can be found throughout the United States
- Host Plants: Aphids can be found attacking and colonizing on an incredible number of plants. The real garden danger arrives in the form of communicable diseases the aphids can bring to your garden.
- Appearance/Habits: Aphids will come in a variety of colors ranging from green, brown, red, yellow, to black. They are generally a wingless soft-bodied insect that colonizes a garden when a few winged aphids land on a suitable host and quickly deposit a number of wingless young on the tender edible part of plants. The young feed on plant sap, maturing in about 10 days, and are ready to produce the next generation. This process repeats until plants become so stressed and weak that winged aphids are reproduced, fly off in search of a new host, and the process repeats. Effected plants decline in overall health until becoming very weak and covered in sticky aphid colonies until eventually die. Large aphid colonies in your gardens will also encourage an unwanted ant population as ants show up to "farm" aphids excretion as a food source. Protecting the aphid colony from natural predators.
- Control: Ladybugs and lacewings are the natural predators of aphids but the aphids breeding is so vigorous it generally can out compete the predators. Removing and destroying effected plants is important in control of the general population in your garden.

Colorado Potato Beetle

- Range: The Colorado Potato Beetle is a native pest in the United States and began its destructive reign as the Great Plains east of the Rockies fell under heavy cultivation in the 20's. It has now spread to all parts of the USA east of the Rockies as well as some other isolated pockets.

- Host Plants: Potato plants are a favorite of these voracious larvae, but the CPB will enjoy a wide variety of plants in the nightshade family such as tomato, peppers, and eggplants.
- Appearance/Habits: Colorado Potato Beetles are large wide beetles growing to ½ " in size. Adults are yellow and black striped hard shell beetles. They will lay an egg mass of yellowish orange eggs on the underside of the host foliage. After the hatch, a large deep red larva will emerge and can very easily skeletonize a plant in little time.
- Control: Aggressive hand picking of larvae is EXTREMELY important for control of spread as well as health of infested plants. Once larvae emerge and are established on plant a dusting of wheat germ will be ingested causing bloat resulting in death.

Cutworm

- Range: There are many species of cutworms ranging throughout the majority of the USA.
- Host Plants: Cutworms will attack a wide variety of garden plants, and because of the great variety of cutworm species, each specie has a group of favorite hosts.
- Appearance/Habits: Cutworms generally appear as a plump caterpillar that can vary greatly in color. They can appear solid or variegated in color, often a greenish black with some stripes. When in moth form they generally are brownish black. They are often recognizable curled up around the base of plants laying in the soil. Cutworms can do severe damage to crops in a variety of ways: They can chew through the stalk of a plant leaving the entire plant toppled from the base. They can climb, eating the fruits and stems, they can burrow, chewing on the root structure, and with Army cutworms they will chew the growth tip of plants before moving on to the next available target.
- Control: By turning the soil over in the fall after intense cutworm pressure you can expose the larvae, or you can deeply bury any pupae. Thorough cultivation in the spring after the plants emerge and frequent cultivations through out the season will expose cutworms to predators. Dig around base of plant destroyed by cutworm to find worms responsible. Planting sunflowers as a trap crop around the garden will attract cutworms and expose them for disposal. Wood ashes around the base of plants may be strong deterrent.

Flea Beetle

- Range: Flea Beetles range throughout the United States.
- Host Plants: Flea Beetles will chose various host plants depending on what variety of beetle is present. Pressure on plants in the Brassicae family can become especially tough as spring turns to the hot summer of Oregon and weed host plants dry up and leave the irrigated garden plants extremely attractive to flea beetles.
- Appearance/Habits: Flea Beetles are generally very small shiny black hopping beetles that will jump for safety when approached by the farmer. Its this characteristic that makes Flea Beetles an extremely challenging garden pest to deal with. There plant damage is easily recognizable by the hundreds of small irregular holes chewed through the foliage of weakened plants. It often looks like tiny shotgun peppering on the leaves.

- Control: Because of the challenge in catching and killing flea beetles without the use of pesticides, the organic farmer has the best opportunity to avoid heavy infestation by applying a good regimen of diversification, crop rotation, and adequate watering. Under watered plants are more susceptible to heavy populations. There has been some effective control using bug vacuum systems. Early use of Remay may help the spread and heavy pressure.

BENEFICIAL AND PREDATORY ALLIES

Lady Beetle (Lady Bug)

- Prey/Habits: The Lady Bug feasts on many small soft-bodied insects such as aphids and spider mites. A single Lady Bug can consume up to 500 aphids a day. They often are most valuable for the farmer or gardener when contained which is why they are often employed in a greenhouse type situation. The larvae of ladybugs are strictly predators, but the adults will sometime feed on pollens and nectars. They are not harmful to plants. Lady Beetles born in the summer time may only live a few weeks to a month however over wintering Lady Beetles can survive up to ten months. The Lady Beetles sold in stores are generally of the variety Hippodamia Convergens or the convergent Lady Bug. The problem with this variety is they have a tendency to flee the sight. Another drawback is that they are generally incapable of laying eggs.
- Appearance: The larvae are black and longer than the adults with speckled yellow or orange dots on there back. The adults are shiny and generally red with some black spotting on there back.

Lacewings

- Prey: Lacewings feed primarily on caterpillars, small beetles, soft-bodied insects such as aphids, and some larvae. Both larvae and adults are predatory, and use there modified jaws to suck the liquid inners out of their prey.
- Habits: Lacewings will mate and lay their eggs on any surface like windows, sides of homes etc. They will molt several times before spinning a silk cocoon and disappearing to pupate. They will emerge relatively quickly and can go through multiple generations in a season
- Appearance: Lacewings are generally a green-bodied long insect with two pairs of wings. Their wings are covered with a lacey veining pattern that is quite delicate. They have large compound eyes next to long antennae.

Trichogamma Wasps

- Prey: Trichogamma Wasps are amazing predators as they parasitize other insects egg masses. They are known to attack over 150 different insect species such as cabbage loopers, hornworms, cutworms, as well as many different moth larvae.
- Habits: Adult wasps seek out eggs following odor. The parent wasp then deposits her egg inside the host egg. Once the wasp hatches, it begins to consume the contents of the egg. The larva then pupates, and eventually chews out of the egg as adult and flies off to locate next host egg.

- Appearance: One of the smallest insects on the planet, they look just like larger wasps but are not much bigger than the head of a pin. Wasps have two pair of wings and the females are equipped with a stinger. This is used for probing possible host eggs.

Praying Mantis

- Prey: The Mantis will eat just about anything that suits its appetite, feasting largely on any insects that happen by. They have been known to eat birds. The mantis will either stay absolutely still and wait for its prey to walk by, or it will slowly and purposefully creep towards its prey. It will then strike out with its folded forelegs, grasping or even impaling its prey. These beneficial garden friends do not differentiate between allies and pests in the garden.
- Habits: The mantis is a strange creature with stranger habits. When the mantis mates, the female will often kill the male in the throws of passion. The male can continue to have fruitful intercourse for several minutes after he loses his head. The mantis often sways back and forth when it moves possibly simulating the wind-influenced movements of the tree or foliage it's hiding on.
- Appearance: The mantis is a large insect, measuring from a centimeter being the smallest variety, to the largest being six inches. Most mantises are green or greenish/brown, however tropical mantis can be pink. They have swiveling heads that can turn a full 180 degrees, and their main defense against larger predators is their camouflage. Some mantises have hollow bodies that they use as an echolocation chamber to "hear" bat frequencies and therefore avoid being eaten by hurling themselves to the ground.

Tachinid Fly

- Prey: The tachinid fly will parasitize grasshoppers, beetles, larvae, caterpillars etc. They will often take on large hosts such as the tomato hornworm. Some not all species are host specific, only preying on there chosen diet.
- Habits: The female tachinid fly will lay her eggs on the host insect skin, however sometimes the eggs will be injected into the body of the host. The larvae then hatch and feed on host insect. Sometimes the host ingests the fly's eggs only to have the fly destroy the host upon hatching. Adults enjoy pollen and nectar as well, and can serve duel purpose in the garden as pollinators.
- Appearance: This large fly often will be seen with a blue metallic abdomen. There are over 1400 North American species in the family Tachinidae. Adults have incredibly distinct bristles on the end of their abdomens. They are a similar size to the common housefly but can occasionally resemble bees.

Soldier Beetle

- Prey: Soldier Beetles enjoy aphids, beetle larvae, caterpillars, moth larvae, and many other common pests. Adults and larvae soldier beetles are both predatory
- Habits: growing nectar rich flowers in the garden can attract some soldier beetles. Adult females lay their eggs in the soil, and larvae emerge shortly there after and begin to feed. Adults will often relax and wait by a good source of pollen, feeding on pollen and nectars until a good prey comes along. The adults will the take advantage of the prey insect that has landed to do the same.

- Appearance: Soldier Beetles, (a.k.a. leatherwings), get their name from the soft uniform like clothed appearance of their wings. They're about half an inch in length and generally have a yellow or reddish underbody with brown or black wings. Larvae are velvety in nature with large protrusions from their heads.

Assessment/Review

- Define IPM, FAB and CBC and think about why they are important concepts.
- Identify a common harmful pest. Discuss its range, host plants, appearance, habits, and methods of control.
- Identify a common beneficial insect. Discuss its appearance, habits, and its prey.

Resources

Ipmnet.org
Uspest.org/wea
OSU Small Farms website
OSU Plant Clinic: plant-clinic.bpp.oregonstate.edu/
Xerces Society: www.xerces.org/pollinator-conservation/organic-farms/

NOTES

ORGANIZING 101: FOOD & FARM ADVOCACY

Learning Objectives

The learner will:

- Understand the purpose, types, and functions of various forms of organizing and activism.
- Examine usefulness and role of goals, strategies and tactics in organizing & activism within the food and agricultural system.

What is Organizing, Advocacy and Activism?

- Activists are individuals who dedicate their time and energy to carious efforts they hope will contribute to social, political or economic change, organizers are activists who, in addition to their participation, work to move other people to take action and help them develop skills, political analysis and confidence. (Andy Cornell)

- Organizers recruit, identify and develop leadership; build community around that leadership; and build power from that community.

- Movement building: long-term strategy, patient base-building, personal engagement between people, full democractic participation, education, development of people's leadership capabilities and coalition building. (Mark Rudd)

- Change the relations of power. (Mike Miller)

- Advocacy by an individual or group normally aims to influence public policy and resource allocation decisions within political, economic, and social systems and institutions; it may be motivated from moral, ethical or faith principles or simply to protect an asset of interest. (Wikipedia)

- Rights may be advocated and served, but responsibilities cannot.

What Purpose Can it Serve within the Food and Agriculture System?

- Create clear solid platform from which to present convincing message.
- Impacting targeted audiences to produce change or improvements.
- Influence public perception and attitude.
- Empowering people to enrich and impact their farm community.
- Foster teamwork, collaborative projects and create social well-being.
- Representation in the Agri-political system and process.
- Right to have a say in what we eat and how we procure it.
- Come up with a set of agricultural policies that stimulate the kind of agriculture that leads to a different kind of diet, health and economy.
- What else?

Why is this Necessary? Brainstorming exercise

- Industrial Food System vs. The System We are Trying to Build and Nurture

How Can We Organize or Advocate for What We Would like to See:

- Overview of approaches to include;
  - media,
  - political campaigning,
  - protest (demonstration, direct action, theater, music, strike/boycott, civil disobedience),
  - lobbying,
  - modeling,
  - propaganda.

This Can Function to:

- Greater understanding of the disconnect between producer & consumer.
- Challenging accessibility misconceptions.
- Changing regulations to accommodate scale.
- Understanding the true cost of food.
- Understanding subsidies.
- Understanding the role of consumers.
- Revive community-based food production.
- Local and seasonal food verses convenience consumerism.
- Provide understanding of the importance of a local economy.
- Address challenges that New and Young Farmers face.

Assessment/Review:

- Why are the various types of organizing & activism important and how do they serve the movement?
- What are the benefits of organizing & activism?
- Impossible to address all food/ag system issues with one solution, campaign or tactic. Organizing can establish shared goals and communication between groups.

Additional Resources:

Please see your 'Resource Guide' for a long list of Advocacy and Issue-oriented Organizations at the local, state, and national level.

In particular, Friends of Family Farmers is a statewide education and advocacy group for socially responsible agriculture in Oregon, http://friendsoffamilyfarmers.org

And the National Young Farmer Coalition is organizing nationally to advocate for the needs and challenges of beginning farmers and ranchers, www.youngfarmers.org

NOTES:

PASTURE MANAGEMENT & GRAZING SYSTEMS

Learning Objectives

The learner will:

- Understand the ecology of pastures and key biological attributes of pasture plants.
- Learn to identify important pasture species.
- Become familiar with grazing systems that build or maintain soil fertility and pasture diversity.
- Learn how to calculate and manage forage production.
- Learn strategies for extended season grazing and winter-feeding.
- Learn how to manage hay fields as part of the pasture rotation.

Pasture Ecology

- Biotic diversity
- Functional roles of different plant groups
  - Grasses fine, fibrous roots hold and build soil
  - Legumes fix nitrogen
  - Other plants (chicory) have deep taproots to keep soil open deeper down
  - Plants that scavenge and accumulate certain minerals or compounds are important to the health of livestock and wildlife.
- Below ground productivity, diversity (more livestock below than above) greater than in annual cropping systems
- Grassland plants and herbivory

Pasture Renovation

- Establish vs. Improving existing pastures
  - Establishment expensive and takes time; tilling, seeding, weed management, no grazing until plants well established
  - Drilling or broadcasting/harrowing into existing pastures

Forage Production

- Seasonal growth curve
- How to calculate forage production using small plots
- Warm season vs. cool season species
- Pasture mixes: legumes, grasses and "weeds"
- Stockpiling
- Rotation Grazing Systems

Management Intensive Grazing (MIG)

- Some history: Andre Voisin, Allan Savory, Joel Salatin
- Stubble height: no less than 3-4"
- Rest periods: depends on season
- Fencing
- Water
- Minerals

- Labor requirements

Fertility Management

- Root production and die-off plays key role in maintaining fertility
- Nutrient cycling:
  - Livestock return most nutrients to the soil:
    - 70% of what goes in comes out again
    - Phosphorous and minerals returned through manure
    - Nitrogen and potassium returned through urine
- Manure/compost/compost tea applications
  - Timing is important
  - Good to know what is in manure or compost
  - Recycle winter feed if possible
  - Tea cost effective way to cover lots of ground
- Mineral may be required
  - Avoid dolomite lime
  - Gypsum good for this area (helps increase Ca:Mg ratio)
  - Other mineral sources

Winter Feed

- Hay production from pastures (spring cutting)
- Hay vs. silage
- Feeding facilities/areas: considerations

Assessment/Review

- Describe forage plants you would hope to fine in a healthy perennial pasture.
- How do you measure forage production?
- Describe nutrient cycling in pastures.
- What is Management Intensive Grazing?

References:

OSU Small Farms Program website has many resources for pasture management
http://smallfarms.oregonstate.edu/pastures
ATTRA resources for grass farming:
http://attra.org/livestock.html#Grass
PSU online pasture grass identification tool
http://www.forages.psu.edu/topics/species_variety_trials/commonpagrasses/index.html
National Forages & Grassland Curriculum Materials for Plant Identification
http://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/plantid
Drawings and diagrams for vegetative ID (collar region):
http://www.caf.wvu.edu/~forage/library/cangrass/index.htm
http://www.ag.ndsu.edu/pubs/ansci/range/eb69-2.htm#INDEX
More online ID tools:

http://www.noble.org/WebApps/PlantImageGallery/PlantList.aspx?PlantTypeID=2&IndexType=CommonName
http://www.hcs.ohio-state.edu/hcs612/forageID.htm
http://www.forages.psu.edu/topics/species_variety_trials/commonpagrasses/index.html

NOTES

GREENHOUSES

Learning Objectives

The learner will…

- Understand the purpose, types, and needs of various greenhouse systems.
- Examine various pest and disease control issues related to greenhouse use.

Purpose of Greenhouses

- Propagation of plants that will be transplanted
- Raising crop from seed to harvest – season extension, increase "climate zone"
- Perennials

Types

- Fully enclosed, automated air, heat, and water systems = Greenhouse
- Hoophouses / High Tunnels
- Low tunnels aka Caterpillar Tunnels
- Cold frames
- Floating row cover

Needs

- Heating/cooling – provide optimal temp range for germination and growth
  - Active vs. passive heat
  - Temperature ranges – cool crops 50 – 70, hot crops 60 – 85
  - Shade cloth
- Air circulation – strengthens plants, reduces chance for fungi and disease
  - Temperature controlled automatic exhaust vents and fans
  - Opening doors or roll-up sides
  - Circulating fans
- Light – in winter, supplemental light can be used to speed growth
- Growing infrastructure
  - Beds – in ground or raised – mostly used for crops to be harvested in greenhouse or perennials
  - Tables & Flats and pots/celltrays – used for crops to be transplanted
- Water –
  - Hand watering
  - Automated sprinkler/mister systems
  - Drip irrigation for in-ground crops

High tunnel/hoop house Design considerations

- Quonset or Gothic shape?
- Quonset: cheaper
  Gothic: more expensive; shed snow; more usable space along walls; better ventilation b/c higher; shed interior condensation rather than drip
- Perimeter to growing area ratio: Wider structures have lower ratio and less heat loss and milder temperature swings. Wider tunnels also tend to be taller and provide

improved ventilation and interior air circulation.
Extra purlins allow built-in trellising options
- Account for snow load and wind load as primary design considerations
- Ballpark costs of structures

General management considerations
- Manage temperature - Avoid cold damage and heat stress
- Manage humidity - Minimize conditions that promote plant diseases by providing ventilation and air movement
- Manage soil moisture- Provide at least 1" per week and manage salt build-up
- When in doubt, vent for cooler temperatures and air movement to reduce heat stress and disease pressure.
- Buffer temperature swings by providing thermal mass such as water barrels and by strategically opening and closing the vents at the beginning and end of each day as dictated by daily weather and types of ventilation that you employ
- Keep the structure as cool and dry as possible.

Plant Propagation
- Cuttings
- Seeding
- Container Formats
  - Cell/Plug trays, Open trays
  - Traditional wooden flats/Soil Blocks
  - Choosing correct size for crop
  - Potting up
- Soil Mixes / fertility / should be wet but not dripping when squeezed
- Filling soil into containers (hands-on demo?)
- # of seeds/cell, # of trays to seed
- Ways to seed: hand, index card/pencil, hand seeders, vacuum seeder, seed depth
- Labeling trays / recordkeeping – date, variety, amount seeded, notes
- Covering & watering in
- Heating to aid germination (bottom heat, germination chamber)
- Provide additional cover to conserve heat as needed
- Irrigation of cell trays – hand, automated sprinklers

Transplanting
- Timing is critical: transplant when roots established but before root bound
- Hardening off – get them used to the elements before transplanting
- Water transplants in tray before transplanting
- Ideally transplant on a cloudy day or if sunny, in the afternoon
- Transplant up to seed leaves on most crops, some can be buried deeper (brassicas, solanums)
- Water in soon after transplanted

Pests and Disease Control

- Common greenhouse pests
  - Aphids
  - Scales
  - Mealybugs
  - White Flies
  - Cabbage Loopers
  - Flea Beetles
  - Mites
  - Slugs
- Healthy plants are most resistant when you provide the following
  - Sanitary conditions – wash flats, pots, tools, do annual cleanout
  - Regular monitoring – remove diseased plants immediately
  - Mechanical monitoring – pick or spray off insects
  - Biological monitoring – use of predatory insects
  - Healthy seed source – seeds can carry disease

Common uses of Hoophouse / High Tunnel for In-Ground Crop Production:

- Extending the season (spring, fall, & winter)
  - Plant earlier in the spring for earlier harvests (e.g. salad greens, carrots)
  - Plant later in the fall for later harvests & overwintering (e.g. salad greens)
  - Can use hooped remay inside of hoophouse for another layer of cold protection
- Increase quality, quantity, & length of harvest for Heat-Loving Crops
  - e.g. Tomato, Pepper, Eggplant, Cucumber – often trellised to structure
  - Increased warmth => increased production up to a point
  - Some control of temperature & total control of irrigation
  - Ability to exclude pests with insect netting on doors

Assessment/Review

- Discuss various types of greenhouse construction.
- What are the basic needs to be provided for in any greenhouse?
- Describe the basic order of events from seeding to transplanting.

Resources

- OBC Northwest Nursery and Greenhouse supplies http://www.obcnw.com/greenhouses.php
- Oregon Valley Greenhouse – www.ovg.com
- *The Hoophouse Handbook*, by Lynn Byczynski
- Fall and Winter Vegetable Gardening in the Pacific Northwest- OSU Extension Service: http:// extension.oregonstate.edu/catalog/pdf/pnw/pnw548.pdf
- NRCS EQIP High Tunnel Initiative (helps fund high tunnels)
- "High Tunnels: Using Low-Cost Technology to Increase Yields, Improve Quality and Extend the Season" - www.sare.org/Learning-Center/SARE-Project-Products/Northeast-SARE-Project-Products/High-Tunnels

NOTES

INTRO TO HORTICULTURE

Horticulture is the science and art of cultivating fruits, vegetables, and ornamental plants. A basic understanding of horticulture and the factors that may increase or decrease plant growth and development can improve your success in growing plants and inform management decisions on the farm.

Learning Objectives

The learner will:

- Understand plant parts and functions
- Learn about some different ways to classify plants and why it matters
- Understand the factors that affect plant growth
- Understand basics of vegetable and fruit production
- Learn how horticultural knowledge can inform management decisions on the farm

Plant Parts and Functions

Roots

- Absorb water and minerals from the soil through root hairs found near root tips
- Some roots also store food
- Plants with taproot system fare better during droughts, but transplant poorly
- Plants with fibrous root systems respond quickly to fluctuations in water and nutrient addition and transplant easily

Shoot

- Functions: Support, Food manufacture, Reproduction, Conduction (food, water, minerals), Sometimes food storage
- Consist of stems, leaves, buds and eventually flowers or cones
- Buds are found at either stem tips (terminal buds) or at point where leaves are attached (lateral buds)
- Adventitious shoot buds arise naturally or can be induced with root cuttings. (eg. dandelions return after pulled because adventitious shoot buds arise on the taproot part left behind)
- Stem modifications exist as a result of evolution
    - Above ground: climbing stems, succulent stems, runners
    - Below ground: bulbs, corms, rhizomes, stolons, tubers, suckers

Leaves

- Food factories for plant (photosynthesis)
- Evaporative water loss through stomates (transpiration)
- Leaf veins provide an identification feature (ex. Monocots vs. dicots)
- Evolutionary modifications

Flowers

- Reproductive structures in angiosperms
- Sepals: protect flower bud from drying
- Petals: lure pollinators (color, fragrance, nectar)
- Stamens and pistils that produce pollen and ovules

- If a plant has both male and female flowers present it is monoecious (corn)
- One plant male and one plant female it is dioecious (kiwis)

Fruits

- After pollination flowers become fruits with seeds
- Fruits derived from several pistil of one flower are aggregate fruits (ex. Blackberry)
- Fruits without seeds are parthenocarpic

Seeds

- Embryonic plants with nutritive tissues (endosperm) and a protective structural coat (seed coat)
- Provide next generation of plants
- Many used as food because of their oil-rich or protein-rich endosperm

Plant Classification

Why does it matter?

- Crop Rotation/Disease Prevention
- Understanding Plant Requirements

How can we classify plants?

- Plant families
  - Alliaceae (onion)
  - Amaranthaceae (Quinoa, Beet, Spinach)
  - Apiaceae (parsley, dill, carrot)
  - Asteraceae (sunflower, artichoke, dandelion)
  - Brassicaceae (mustard, cabbage, radish)
  - Cucurbitaceae (cucumber, melon, squash)
  - Fabaceae (bean, pea, lentil, clover)
  - Lamiaceae (mint, basil, lavender)
  - Poaceae (corn, wheat, rice, barley)
  - Rosaceae (rose, apple, blackberry, plum)
  - Solanaceae (tomato, pepper, potato)
- Based on edible part
- Based on life cycle
- Based on climatic adaptation
- Based on pollination
- Based on special uses

Factors affecting plant growth

- Light - LAI (leaf area/soil unit), Density (competition), Photoperiod response, Intensity, Quantity (saturation), Quality (radiation), Dark Periods
- Temperature - Controls rate of photosynthesis and respiration, Thermoperiodism, Growing Degree Days, Vernalization, Hardening, Extreme Heat/Freezing
- Water - Regulate Plant Processes, Uptake depends on soil, Irrigation delays maturity, Critical times – flowering, fruit set, seed set, ripening, Transpiration – solar radiation, air temp, wind speed, Root Factors – size, permeability (new vs. old), extension, resistance, Plant Factors – height (wind), cuticle (waxy, hairs), color (dark absorbs heat)

- Nutrient Availability
- CO_2
- Environmental Factors: Soil, Wind/Weather, Biotic Factors
- Photosynthesis and Respiration
    - Photosynthesis: Turns solar radiation into chemical energy
        - Requires CO2 and H2O (+minerals); creates O2
        - Maximize light energy captured by plant
    - Respiration: Occurs in gradual steps to provide energy to cells; occurs in light or dark
        - O2 limiting factor – anaerobic (e.g. flooding, fermentation)
    - Sinks (Fruit to Seed) & Sources (leaves)

Production Basics

Vegetable Production: Crop and Cultivar Selection, Soil Preparation, Fertilization, Planting, Irrigation, Weed and Pest Control, Harvesting, Pre-Marketing Operations - washing, trimming, waxing, curing, precooling, grading, packaging, shipping, preservation

Fruit Production: Site selection, preparation, planting, and pruning; Weeds and Orchard Floor Management**;** Fertilization**;** Irrigation**;** Pollination and thinning**;** Pest management**;** Harvesting**;** Pre-Marketing Operations - washing, waxing, pre-cooling, grading packaging, shipping, preservation

Horticultural management decisions

- Profitability
- Environmental/social considerations
    - Input reduction
        - Minimize inputs that cost too much, consume energy and damage the environment
        - Integrated pest management: using biological, cultural, physical and chemical tools such that economic, health, and environmental risks are minimized
    - Soil Conservation
    - Water Quality
    - Air Quality
    - Crop Diversity
- Individual beliefs/goals
- Lifestyle choices
- Applied examples: fruit quality, frost anticipation, nutrient management, training systems, plant spacing, crop rotations, and determining what you can grow

NOTES

IRRIGATION

Learning Objectives

The learner will:

- Understand reasons for irrigation
- Learn to recognize the effects of water stress
- Learn methods of determining the proper frequency of irrigation
- Examine various system designs and delivery methods and investigate specific advantages and disadvantages.

Why Irrigate?

- Maintain and moderate best temperature for plant life
- Gives structure and support to plant – water molecules in tissue
- Unlocks biological and chemical processes in the soil that support plant growth
- Plants use water to form oxygen and carbohydrates
- Irrigation protects crops from frost

Effects of Water Stress

- Water stressed plants have lower immunity to pests and disease
- Decreased yield. Plants are particularly sensitive at these stages
  - Flowering stage
  - Fruit/yield set
  - Seedling
  - Fruit ripening

Terms and Definitions

- *GPM (gallons per minute)* – A measurement of flow (volume of water from given source in one minute)
- *PSI (pounds per square inch)* – A measurement of water pressure (the force that water exerts on a given area)
  - (e.g. Water coming out of a pipe can be expressed both in terms of rate of flow and the force applied to that flow, as in 35 GPM @ 50 PSI.)
- *Velocity* – Rate at which water moves through a pipe system. As velocity increases, pressure decreases. Velocity should be 5ft/sec or less. (Use table to determine.)
- *Evaporation* – Loss of water from soil to atmosphere
- *Transpiration* – Loss of water from plant to atmosphere
- *Evapotranspiration (ET)* – Evaporation plus transpiration
- *Evapotranspiration rate (ETo)* – Measurement of ET in inches/day
- *Hygroscopic Water* – Water held too tightly in soil to be available to plants
- *Capillary Water* – Water that is held in pore spaces of soil; available to plants
- *Gravitational Water* – Water draining from soil; not available to plants
- *Capillary Action* – Movement of water in soil from wet to dry areas
- *Percolation* - Movement of gravitational water down through soil
- *Permanent Wilting Point* – Boundary between capillary water and hygroscopic water.

Plant begins to sustain damage and will die if water is not applied.
- *Field Capacity* – Boundary between gravitational water and capillary water (upper limit for soil moisture available to plant)
- *Available Water* – Amount of water available to plants

Frequency of Irrigation

Soil Test Method

- Manual test – Soil is felt and observed at the root zone of the plant. Water is applied when soil is at 50%-75% of field capacity (depends on crop specifics). Charts are available as a guide to this method, but judgment is largely based on site-specific experience.
- Mechanical test – Tensiometer

Soil Budget Method

- Calculate site ETo
  - Get from local extension office
  - Measure time for one inch of water to evaporate from a pan.
- Replace water as it evaporates from field capacity using measured amounts from an irrigation system.
- Example/Exercise: *If local ETo is .4in/day, how much water needs to be applied in a week?*
  - Formula is PR = (96.3xGPM)/(SxL)
  - PR = precipitation rate measured in in/hr
  - 96.3 = constant
  - GPM = gallon per minute water flow in measured area
  - S = in-line spacing of sprinklers or emitters in feet
  - L = lateral spacing of sprinklers or emitters in feet

Factors Affecting Irrigation Frequency

Climate

- As temperature increases, ETo increases
- As wind increases, ETo increases
- As humidity increases, ETo decreases
- As precipitation increases, ETo decreases

Soil Type (see charts)

- Coarse – sand – drains quickly, increase frequency of irrigation
- Medium – loam – drains moderately
- Fine – clay – drains slowly, decrease frequency of irrigation

Slope (see charts)

- The steeper the slope, the less water the soil can absorb before run-off.

Crop Specifics

- Water loving or drought tolerant
- Germinating direct seeded crops

- Dry down during ripening
- Perennials

Irrigation Systems Design Considerations

Determine Source

- Pond or other open source (gravity feed or pump)
- Well

Determine GPM and PSI at delivery point

- Flow test with bucket and stopwatch
- PSI test with gauge
- Determine pipe size using tables
- Determine delivery method based on GPM, PSI, and field requirements

Drip or Micro

- For row crops, typically T-tape coming from 1/2" to 1" manifold, with filters and pressure regulators.
    - *Advantages*
        - *Good for limited water source*
        - *Efficient direct delivery of water to root zone*
        - *Fewer Weeds*
    - *Disadvantages*
        - *Maintenance on filters*
        - *Limited life*

Overhead Sprinkler

- Buried PVC (A system in which sprinklers come directly from a buried PVC via a vertical riser)
- Must be designed correctly and buried deep enough to avoid cultivation
    - *Advantages*
        - *More ambient cooling*
        - *Longer life*
    - *Disadvantages*
        - *Less efficient*
        - *Can promote mold/disease*
        - *Takes higher flow*

Aluminum Hand Line (Pipe and sprinklers are all above ground and are supplied with water from a riser valve coming off of the main system at the top of the row or field)

- Requires less buried PVC.
- -20'-30' pieces are moved as needed. Have impact heads. Connect to fittings at top of field or row.

Flood

- Sheet of water over established vegetation. Best for pasture or cover crop.

Designing your own irrigation system

- Based on your crops, soil profile and infrastructure in place, you may decide to set up one or more of these systems.
- Things to remember:
  - Use gravity to your advantage if possible
  - Design water dispersal systems on contour to ensure even distribution
  - Design in redundancy and flexibility – if one piece breaks you may need to be able to irrigate without it.

Assessment/Review

- What are the symptoms and effects of water stress in plants?
- What are some factors affecting irrigation frequency?
- Name several types of irrigation systems and discuss advantages and disadvantages of each.

Resources

Rain Bird Drip/Standard Irrigation Design Manual
Turf Irrigation Manual
http://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/1.5-irrigation.pdf

NOTES

ORCHARDING / PERENNIAL CROPS

Learning Objectives
The learner will:

- Be introduced to layout and set-up for perennial crops
- Learn about maintenance of perennial crops

Set-up

- The Trees
- Trellis
- Irrigation
- Layout

Maintenance

- Seasonal Management
- Tools & Equipment
- Pest and Disease Control

Flow

- Harvest & Yields
- Marketing
- Economics

Resources:
The Fruit Expert by Dr D.G. Hessayon
The Backyard Orchardist by Stella Otto
The Backyard Berry Book by Stella Otto
The Holistic Orchard by Michael Phillips
The Apple Grower by Michael Phillips
The Biodynamic Orchard Book by Ehrenfried Pfeiffer
Growing Tree Fruits and Nuts in the home orchard - Oregon State University Extension
The Home Orchard by Chuck Ingels

NOTES

PERMACULTURE

"PERMACULTURE IS A CREATIVE DESIGN PROCESS BASED ON WHOLE-SYSTEMS THINKING INFORMED BY ETHICS AND DESIGN PRINCIPLES" -PERMACULTUREPRINCIPLES.COM

Learning Objectives

The learner will:

- Know the ethics of Permaculture
- Understand the basic principles of Permaculture
- Learn steps for new Site Assessment
- Practice Permaculture Design Methodologies

3 Ethics of Permaculture

1. Earth Care- care of all living things, water, land, air
2. People Care- providing basic needs to people, promote self-reliance and responsibility
3. Fair Share- distribution of surplus, labor, information, resources, skills, etc. (nature doesn't hoard!)

Principles of Permaculture

- Observe and interact
  - take time to get to know your land and environment before making any changes or big decisions. this is your time to plan.
- Catch and store energy
  - develop systems to collect resources when they are abundant so you can use them in times of need (i.e. rain water harvesting systems to be used for irrigation)
- Obtain and yield
  - ensure that the "juice is worth the squeeze." is your yield worth the amount of time and energy you are putting into it?
  - design your system so that it works FOR you- least amount of energy invested for maximum output
- Apply self-regulation and accept feedback
  - know your limits; seek help when necessary
- Use and value renewable resources and services
  - i.e. solar power or sustainable wood lots
- Produce no waste
  - there is no such thing as waste- everything can be a resource (i.e. food scraps can turn into compost)
- Design from patterns to details
  - use the many natural patterns found in nature (i.e. spirals, bee hives, snow flakes) as ideas for system design. these patterns exist in nature for a reason.
- Integrate rather than segregate
  - create relationships amongst the various parts of your system so that they work together
  - Stacking Functions- one element can support many functions

- Use small and slow solutions
  - small and slow systems are easier to maintain than big ones, making better use of local resources and produce more sustainable outcomes
- Use and value diversity
  - diversity = stability
  - make sure that the important functions of your system are supported by various elements (redundancy)
- Use edges and value the marginal
  - the point at which things meet often creates the most interesting and productive areas
- Creatively use and respond to change
  - the problem can be the solution

<u>Site Assessment Steps</u>

1. **Observation**
2. **Sector Analysis**
   - *Sector: elemental energies and how they move across your landscape*
   - how do these elements interact with the land?
     - water
     - sunlight
     - wind
     - wildlife
     - humans/neighbors
     - fire
3. **Existing Elements**
   - what already exists on the sight? (i.e. buildings/infrastructure, materials, electrical lines, pipes, wells, ponds, sacred sites, etc.)
4. **Vegetation/Plant Communities**
   - what vegetation exists on the site? (i.e. forests/trees, natives, invasives, indicators)
5. **Micro Climates**
   - *small areas with different climate than overall area* (i.e. compost piles, trees, windbreaks, rocks)
   - idea is to create many micro-climates throughout your site
6. **Climate**
   - know your average climate to help you know what to plant, when, where, etc.
     - precipitation
     - temperature
     - frost
     - humidity
7. **Site History**
   - what was there before you?
   - what is the zoning?
8. **Topography**

- understand the topography and slopes/contours of your land

9. **Soil**
    - do a soil test to determine type of soil you have and what macro and micro nutrients already exist in the soil

<u>Design Methodologies</u>

1. **Zones- designing your site in terms of the frequency in which you need to visit certain elements or areas**
    a. Zone 0: self or home (where you spend the most time)
    b. Zone 1: components needing continual observation (i.e. greenhouse)
    c. Zone 2: less intensively managed (i.e. small fruit trees, main veggie crops)
    d. Zone 3: farm zone or commercial crops
    e. Zone 4: local forest, pasture land, wild gathering of fruits and fuels
    f. Zone 5: natural, unmanaged environment, wild area
2. **Input/Output Analysis**
    a. consider all of the important elements on your land and list the needs (inputs) and yields (outputs) of each element
    b. compare the needs of one element to the output of another element- are there any connections/relationships you did not know existed?
3. **Random Assembly**
    a. write down each important element on a note card and mix them together
    b. pick 2 elements out and try to creatively see how they may be connected or can benefit each other (this will help you to think outside the box!)

Resources:

- **Permaculture In A Nutshell** By Patrick Whitefield
- **Permaculture: A Designers' Manual** by Bill Mollison
- **The Earth Care Manual** by Patrick Whitefield
- **How To Make A Forest Garden** By Patrick Whitefield
- **Forest Gardening** by Robert Hart
- **The Permaculture Garden** By Graham Bell
- **Gaia's Garden** by Toby Hemingway
- **Gardening at the Dragon's Gate** by Wendy Johnson
- **Earth User's Guide to Permaculture** by Rosemary Morrow
- **Food Not Lawns: How To Turn Your Yard Into A Garden And Your Neighborhood Into A Community** by Heather C Flores
- **The Resilient Farm and Homestead** by Ben Falk
- **The Permaculture Handbook: Garden Farming for Town and Country** by Peter Bane
- **The Salad Garden** By Joy Larkcom
- **How To Make A Wildlife Garden** By Chris Barnes
- **The Wilderness Garden** By Jackie French

NOTES

PLANT PATHOGENS

Learning Objectives

The learner will:

- Become familiar with various types of plant pathogens or disease agents.
- Examine various methods of disease management.

Plant Pathogen Overview

- A plant pathogen is any harmful introduced infectious agent, organism, or condition that reduces a plant's overall vitality, inhibits its growth, or limits the ability of the plant to survive and reproduce.
- Pathogens can be delivered in a multitude of different ways. These include: bacteria, fungi, viruses, nematodes, oomycetes, and abiotic toxicities.
- There are several different factors that need to be present in order to create an outbreak of disease on the farm. The pathogen must be present. There must be suitable host plants around. And there must be favorable environmental conditions for the growth and development of that particular plant pathogen.

Disease Agents

- Bacteria: These single cell organisms absorb the nutrition from their host plant and thrive by killing the plant and living off of their decomposing organic matter. This is often described as a saprophytic relationship. Bacterial pathogens cause blights, rots, and wilts.
- Fungi: Fungal pathogens are spread by many different environmental conditions such as wind water, seeds, human and other non-human vectors. (A vector is a host capable of transferring a particular pathogen.) Fungi that are capable of regenerating spores during the growing season and re-infecting plants are known as polycyclic. Fungi that must wait for next season are monocyclic.
- Viruses: Viruses are pieces of genetic material (RNA/DNA) and disturb the plants by mimicking naturally occurring genetic abnormalities. There are more than 700 plant viruses known. Viruses can be spread by tractors or equipment, tainted seed, or by a traveling vector.
- Nematodes: Nematodes are both a pathogen and a vector. Nematodes are microscopic worms and are one of the most abundant phyla with over 20,000 different species. A nematode either infects a plant by injecting a needle like mouth into the plant or it actually enters the plant with its entire body. The nematode's saliva is the infecting agent and disturbs the metabolic process of the plant and causes disease and death.
- Abiotic: This refers to deficiencies in the soil or surrounding environment that cause a debilitating illness that is harmful or fatal to the plant.
- Oomycetes: These organisms act much like a fungi, however they have a very different evolutionary history. They have mobile spores and can be primarily spread by both wind and water. Vectors can also spread them. An example of an oomycetes is "downy mildew" also known as "damping off."

Disease Management

- Plants often have developed natural defenses against pathogens. Some plants have developed disease tolerance. Some plants have developed disease resistance. Plants that are disease resistant will exhibit characteristics that actually repel certain harmful disease known to attack that particular plant. Plants that are disease tolerant can live with a problem pathogen but survive without any substantial reduction in yield or overall health.
- Proper greenhouse management can be extremely helpful in the control of outbreak and spread of pathogens. Disinfecting all soil trays and propagating mediums greatly reduces the incidence of pathogens.
- A solid approach to crop rotation will also limit the spread and overall effect of certain diseases. This is a result of diversity increasing overall vitality, limiting host species, and reducing environmental conditions needed for disease to flourish and spread in similar varieties or families of plants.
- Recognizing pre-existing factors that may contribute to pathogen outbreak is an important aspect of disease control. An example would be being vigilant and wary of downy mildew in a very wet or coastal environment.
- In some organic situations, chemical control of disease is necessary and allowed by organic standards. Effected host plants can be physically removed or treated with such elements as copper, sulfur, or neem. It is always recommended that you consult with an expert before using or adding any amendment to your fields to help control disease.
- Overall plant vitality is probably the single most important element for fighting and combating disease in your garden or field. Pathogens have the tendency to attack weak or stressed plants in the garden. If a disease establishes itself using the weaker plants it can often jump to the stronger crops. Therefore, maintaining conditions favorable to general plant vitality can significantly reduce the occurrence of disease. Removing harvested plants quickly and composting effectively will reduce instance of pathogens as well.

Assessment/Review

- What is a pathogen vector?
- What are several types of pathogens and how do they affect the plant?
- What essential disease prevention methods should be used on the farm to reduce the risk of pathogens?

`

Resources

- The Pacific Northwest Disease Handbook
  http://pnwhandbooks.org/plantdisease/
- OMRI (Organic Materials Review Institute)
  http://www.omri.org/

NOTES

POST-HARVEST HANDLING AND FOOD SAFETY

Learning Objectives

The learner will:

- Understand proper harvest and post-harvest handling techniques for various produce
- Learn about other Food Safety considerations

Harvesting

- Harvesting equipment: knives, totes, shade, cart. Pick the appropriate tools for the job. Carry all the necessary items with you. Keep your knives SHARP!
- Schedule your harvest day according to the weather and what you are processing
- Know the needs of each crop: should it be cut cool, dry, etc (beans/peas, greens, roots, etc.)
- Processing area. Should be central to where you are working. Option of a mobile processing area. Key needs: sprayer, dunk tank, waste disposal, post-wash drying space. What crops need which method?
- Efficiency: Farming often seems to be simply about moving things from one place to another. Do it with the least amount of time and effort. Plan ahead.

Post-Harvest

- Packing: what kind of bin or bag will you use? Where is it going? When?
- Cooler/Root cellar: where is it, what's the temperature, how long will you keep things there, how is it organized/accessed?
- Transportation – it's not over until the customer has it in hand. Different concerns for different sales outlets: market, CSA, wholesale

Specific Handling Procedures Based on Type of Produce

- Broccoli and Cauliflower should be iced and or hydro-cooled immediately following harvest.
- Cucumbers should be hydro-cooled immediately and washed down to remove any "spike" that may be present. Cucumbers can be stored in lugs or flats with lids and should be kept cool between forty and fifty degrees.
- Eggplants should be handled with delicate care following harvest. The skin shows rough treatment and punctures with ease.
- Tomatoes can be harvested at any time of the day, and should be packed gently into a box immediately following. They should not be stacked more than four high in a box. Large heirloom varieties have a tendency to be VERY delicate and should be handled appropriately.
- Leafy greens need a cold-water bath after harvest. It makes a world of difference with wilt. Any loose greens that are going to be bagged need to be spun dried before bagging.
- Melons can be harvested at your leisure although a melon harvested in the cool of morning will have a better texture.
- Potatoes can be harvested anytime of the day but should be handled carefully afterwards.

- Onions/Garlic generally need some curing after harvest.

Food Safety
Common sense vs. a GAP (Good Agricultural Practices) audit

- Both are methods of risk management – the risk is inherent
- Understanding pathogens
- Statistics
- Legal perspective/liability
- Traceability
- Some issues are dependent on your customer

Key production considerations:
Everyone wants to sell clean, healthy food that won't make anyone sick. There are some basic steps:

- Water & irrigation
- Soil amendments - manure
- Equipment cleaning

Key harvest considerations:

- Food contact surfaces
- Soil contact
- Tools
- Water used during harvest
- Transportation
- Containers
- Cooling
- In fielding packing vs. wash and pack-out area

Key processing considerations:

- Wash water
- Personal health & hygiene
- Effective sanitation practices for facility, equipment, utensils

Key storage considerations:

- Temperature/proper cooling
- Moisture/respiration
- Packaging

Resources
http://atinadiffley.com/food-safety-and-post-harvest-handling/#Food_Safety_Action_Plans_and_Whole_Success_Materials

NOTES

POULTRY MANAGEMENT

Learning Objectives

The learner will…

- Understand the role poultry in farm system
- Learn how to care for chicks
- Learn how to raise chickens for eggs, meat, and other
- Learn about pasture-based production models
- Gain a basic understanding of the legalities and choices for processing

Why Raise Chickens

- Entertainment
- Eggs
- Meat
- Fertilizer
- Bug and Weed Control
- Breeding Stock

Chicken Terminology

- Hen — mature female chicken > 1 year
- Pullet — immature female chicken < 1 year
- Cockerel — male chicken < 1 year
- Rooster male — chicken > 1 year
- Straight / hatchery run — unsexed
- Molt — natural process of shedding feathers
- Brood — to care for batch of chicks
- Broody — hen that sets
- Crop — pouch where chicken digests food
- Vent — opening through which hens lay eggs

Brooding

- Equipment
- Feeders
- Waterers
- Temperature
- Litter
- Nutrition
    - Grit critical - use stream sand - usually higher mineral content
    - Add hay chaff - seeds of perennials generally higher in nutrition than annuals (grains)
    - Fresh green vegetable matter - garden waste, grass clippings (not too much, especially meat birds - bred for hot feeds)
    - Medical supplies

Chicken Breeds

- Layers
- Meat

Egg Production

- Production layers: 250-280 eggs / year
- Average brown egg layer: 150-200 eggs / year
- Hens begin laying at about 5-6 months of age
- Production falls off as hens age - replace every 2-3 years to maintain profit
- Egg color:
  - White (Leghorns)
  - Brown (Barred Rock, Rhode Island Reds, Buff Ophington, Black Australorp, New Hampshire Reds)
  - Colored (Auracana/Americana) 1 egg every 3 days
- Yolk Color - affected by plant pigments beta carotene and xanthophylls (green plant material or yellow corn will turn yolks orange)

Winter Production

- Egg production will decline in the fall and may cease during Nov - Jan
- Can sustain with lighting:
  - 40-60 watt bulb, 16 hours / day on timer
  - 15 watt bulb 24 hours / day

Egg Processing

- Storage:
  - 1 month or more in the fridge
  - 2-3 months < 55 degrees at 75% humidity
  - Egg quality diminishes in storage

Egg Handling

Nest boxes
Transport
Washing
Candling and inspection
Egg Cartons
Egg Handlers License

Chicken Coop Design

- Stationary vs. Mobile
- Should provide protection from weather, drafts
- Need adequate ventilation
- Feeders - 5-6 inches per bird
- Waterers - 1-2 inches per bird
- Roosts - 8 - 12 inches roost space per adult, 15 inches between roosts (sloping)
- Nest boxes - 12" x 12" spacing, 4" lip across front, 2 feet off floor, 1 box per 5 birds

Disease Prevention

- Sanitation
- Adequate space
- Fresh air / ventilation
- Proper nutrition
- Cull as needed
- Protect from predators
- Wet weather and standing water
- Mixing poultry species

Common Poultry Diseases

- Infectious Laryngotracheitis
- Mycoplasmosis
- Coccidiosis
- Internal and external parasites
- Bumblefoot

Pastured Poultry Production

- Feed requirements drop 30 - 50% (layer breeds)
- Housing:
  - Eggmobile (henabago)
  - Hoop houses
  - Variations on the chicken tractor
- Grass height important (too tall, will be trampled)
- Rotation with other livestock

Pastured Poultry Processing

- Requirements for Federal Inspection
  - FSIS overseas and licenses facilities
  - Inspects birds themselves
- Exemptions from Federal Inspection
  - No more than 1,000 birds per year
  - All poultry must be raised on producer's own farm
  - Producer may not buy or sell offsite birds
  - No poultry is distributed outside state
- State of Oregon
  - Currently Oregon law under the '1000 bird exemption' allows for poultry growers to process up to 1,000 birds onsite. These birds can only be sold off the farm. In order to sell at farmer's markets, restaurants, and retail outlets they must be processed in an ODA licensed facility. ODA licensed facilities allow for up to 20,000 birds to be processed annually. Some farms in the area have upgraded their onsite slaughtering facility to be ODA licensed facilities. There are only a handful of poultry processors in the State of Oregon.

Marketing

- Eggs: Direct vs. Retail
  - Designations: certified organic, free-range, free-nested, cage free, pastured
- Meat

Assessment/Review

- What role can chickens play in an agricultural ecosystem?
- What are the benefits of pastured poultry production models?
- List important considerations for care of chicks.
- What are the basic feed requirements of chicks? Chickens?

References

The Chicken Health Handbook. Damerow, G. 1994, Storey Books
Pastured Poultry Profits. Salatin, J. 1993, Polyface, Inc, Swoope, VA.371 pp.
www.sustainablepoultry.org

Chicken Production Budget Worksheet
http://nwdirect.wsu.edu/barriers/poultry_spreadsheet.php

Oregon State University Small Farms >Poultry
http://smallfarms.oregonstate.edu/poultry

Sources for Chicks

Jenks Hatchery, Tangent, OR
Phinney Hatchery, 1331 Dell Ave., Walla Walla, WA
Murray McMurray, Webster City, IA

NOTES

SEED SAVING AND SEED STEWARDSHIP
The Path to Locally Adapted Seed and True Food Freedom

Learning Objectives
The learner will:

- Understand the basics of seeds, including botany, pollination, breeding and saving.
- Learn the process of properly drying and storing seeds.

Advantages to saving your own seed

- A profound act of social and ecological empowerment
- Saves you money
- Preserve agricultural biodiversity
- Be part of an ancient tradition
- Freedom and self reliance
- Human right: Like free speech, if you don't use it you might lose it.
- Consistent access to good quality seed. Companies drop varieties all the time.
- Select for adaptation to disease, pests, climate and soils
- Have your own family heirloom
- Fun and engaging!

Basic Botany

- Nomenclature (Family->Genus->Species->Variety)
  - Ex. Carrots = *Apiacea -> Daucus -> carrota* - > "Scarlet Nantes"
- Plants cross within a species (i.e. Zucchini (*Cucurita pepo*) will cross with pumpkins (*C.pepo*), but not with buttercup squash (*C.maxima*) but rarely across species barriers (think mules)
- Flower parts (Pistil/ Stamen/ Anther/ Style/ petals /sepals / ovary)
- Annual vs. biennial plants
- Biennials include carrots, beets, parsley, onions, leeks, cabbage family, kale, Swiss chard
- Monecious vs. Dioecious (i.e. spinach)

Pollination

Insect Pollinated – cucurbits, Brassicas, onions, leeks, carrots, parsley
Wind Pollinated – grasses (corn), beets, chard, spinach, oaks,
Self-Pollinated – Tomatoes, peppers, eggplant, lettuce, beans, peas
Extra-floral nectarines – plants entice pollinators with the sweet stuff!

The Fundamentals

Open Pollinated, Heirloom	**Hybrid Seed**	**GMO seed**
Plants reproduce according to their natural mechanism (self, birds, bees, wind).	Hybrid F1 - Two lines are combined in controlled pollination.	GMO Are usually hybrids (unless they are clones, as with potatoes) and not readily available to gardeners.
You can save seeds! And if you do it right, they will be true-to-type	You may or may not be able to save seed, and they are generally NOT true-to-type	Patented Genes: You will get sued if caught saving seed.
Saving seeds = stewardship to adapt to conditions	Perform the same way in any location if given enough fertilizer	Same as for hybrid aka: an evolutionary dead end

Cross-Pollinated Crops – need isolation from one another (usually a minimum of ½ mile)

Self-Pollinated Crops – less or no isolation requirements

Timed Isolation – planting times are staggered to avoid overlapping flowering (works well with corn)

Inbreeding Depression – minimum population sizes are needed with the cross-pollinated crops to avoid "bottlenecking" the genetic diversity of the population.

- Generally 120 plants are required, an exception is the cucurbits, where you only need 10 plants.
- Inbreeding depression is the result of too small of a population = reduced vigor, smaller yields, more susceptible to pests and disease.

Hybrid – refers to a crossing of two separate varieties. An F1 hybrid is generally when two uniform inbred lines are crossed. The resulting generation is the F1 (for first filial), and then next season would be the F2 and so forth.

Heterosis – is the term to describe hybrid vigor which results from broadening the genetic base (the opposite of inbreeding depression)

Grex- a hybrid with many parents

Strain cross – crossing two strains of the same variety

Sources for good seed

- Seed swaps!
- Local "Farm Direct" Seed Companies: Adaptive Seeds, Wild Garden Seeds, Peace Seedlings/Peace Seeds, Uprising Seeds (WA), Siskiyou Seeds (Southern OR),, Green Journey Seeds, Turtle Tree (NY)
- Good seed companies that repackage seed: Territorial, Fedco, Johnny's, Nichols, Bountiful Gardens, Gourmet Seed International (European), Kitazawa (Asian), etc...

Planning your garden for seed saving

- Casual seed saving vs deliberate
- Space and Time?
- Dry down/irrigation, isolation, population size
- Crop rotations
- Many crops you can eat and save seed from

Selection: Simple plant breeding for locally adapted seed

- Save the best and eat the rest
- Seed saving is plant breeding
- Selection events maintain health and resilience long term by encouraging adaptation. Pests and problems are essential to the process.
- Plants start to resemble their stewards.

Harvest, Cleaning and Storage

- Wet Processing – often vegetables we eat the fruits of (squashes)
- Fermentation processing – tomatoes, cucumbers
- Dry Processing – Harvest (cut), Thresh (dance!), Winnow (two buckets in front of a box fan)
- 80% water weight - DRY –
  - Food dehydrator with thermostat,
- Storage and moisture control – dark, dry, cool, and rodent-free! Ziplock bags in totes.

Organization and Labeling – 90% of seed saving is labeling. Do it well, don't rely on your memory.

Other information

Seed To Seed – Suzanne Ashworth
Breed Your Own Vegetable Varieties – Carol Deppe
The Organic Seed Grower - John Navazio
Organic Seed Alliance Publications
Save Our Seed Guides, Jeff McCormack
Seed Ambassadors

NOTES

SOIL SCIENCE

The soil is the life force of the farm; farmers rely heavily on it to perform and provide, often year-round. Understanding the characteristics of your soil can inform planting, irrigation, amendment and cover crop decisions, as well as how you care for your soil health on a long-term scale. It also plays a larger role in the health of a watershed or regional eco-system by combating erosion and nutrient pollution in our streams and rivers. Individuals who study and pay close attention to their soil's structure and content will see significantly higher yields, lower water usage, more nutrient-rich produce, and easier, lighter field work.

Learning Objectives

The learner will:

- Understand how soils form
- Understand diverse soil characteristics and how they effect crop growth
- Learn why and how to take soil samples, what to test for and what to do with the results
- Learn how to manage for healthy soil ecosystems, increased fertility, and sustainable crop production

How Soils Form

- Climate, Organisms, Relief, Parent Material, Time
- Soil Toposequence: Moving from the ridge top to valley bottom, soil characteristics vary greatly.

Soil Characteristics

- Soil Components: Minerals (45%), Air and Water (25% each), and Organic Matter (usually 2 - 5%)
- Soil Texture: Sand, silt, & clay, the soil triangle, and associated properties:
  - Sandy soils - low water and nutrient holding capacity, droughty
  - Clay soils - high water and nutrient holding capacity, but low permeability, poor tilth
- Soil Nutrient Profile: major and minor nutrients, trace elements
- Macronutrients — NPK (three numbers on every bag of fertilizer, e.g., fish meal = 10-6-2)
  - Nitrogen = healthy foliage growth, essential for photosynthesis
  - Phosphorous = energy storage, root growth, disease resistance
  - Potassium = enzyme activity, transpiration and translocation, N uptake, protein synthesis
- Micronutrients
  - Sulfur, Calcium, Magnesium, Boron
  - Others: copper, iron, chloride, manganese, molybdenum, zinc
- pH — impacts root ability to locate and uptake nutrients
- Cation Exchange Capacity: carrying capacity of negatively charged humus and clay particles to hold & transfer nutrient cations (Calcium, Magnesium, Potassium, sodium & ammonia)

Soil Biotic Community

- We know that an acre of soil has the potential to support or produce 2000 lbs of beef (cow / calf pair), 5 sheep, and lots of chickens, for example, but we rarely consider the extent of the soil fauna living underground: 1 acre of topsoil contains approximately 900 pounds of earthworms, 2,400 pounds of fungi, 1,500 pounds of bacteria, 133 pounds of Protozoa, 890 pounds of arthropods and algae, and small mammals.
- Earthworms – air & water penetration, high-nutrient castings, secretion of plant growth stimulant, natural soil tiller.
- Arthropods – sow bugs, centipedes, slugs, snails, and springtails: primary decomposers.
- Bacteria – make plant growth hormones, make nutrients and minerals available to plants, fix atmospheric nitrogen, fight root diseases, and detoxify soils.
- Fungi – break down OM and release nutrients available to plants, produce plant hormones and antibiotics, mycorrhizal associations.
- Actinomycetes – threadlike bacteria that look like fungi: decompose OM, produce root disease-fighting antibiotics, and produce a sweet, "earthy" smell.
- Algae – upper ½ inch, fix nitrogen and build soil structure by producing biologic glues.
- Protozoa – free-living organisms that swim in soil water, eating bacteria and speeding up the nutrient cycle.
- Nematodes – eat decaying plant litter, bacteria, algae, protozoa, and other nematodes – only a few species harmful to plants.

<u>Key to managing for a healthy soil community: build soil organic matter</u>

Soil Organic Matter

- Building SOM: cover crops, field rotations, compost and compost tea, etc.
- Low-Tillage systems
- Nitrogen Cycle: role of N, and how to manage it.

Soil Testing and Assessment

- What to test, how to test, when to test: texture, major nutrients, minors and trace, pH, CEC, soil biotic community.
    - NRCS Web Soil Survey
    - Test early to get a baseline, test different areas separately

Assessment/Review

- How is soil formed?
- What are some important soil characteristics?
- Explain cation exchange capacity and how to improve it.
- Describe a cropping system that improves soil organic matter and enhances the soil biotic community.

Resources

Soil Test Interpretation Guide - http://extension.oregonstate.edu/sorec/sites/default/files/soil_test_interpretation_ec1478.pdf
NRCS Web Soil Survey

NOTES

TRACTORS

Tractors are awesome. They are incredibly valuable and important tools on most farms, and should be celebrated! It's also important to remember that there's a time and a place for using them, they can be very dangerous, they run on fossil fuels and they can be costly to fix… so use them wisely and take good care of them!
This lesson plan is geared towards the operation of a Kubota 3410, but nearly all the information is transferable to most small farm tractors. However, it is very important when operating any tractor that one has a solid fundamental understanding of the particular tractor's nuances, lever and gear positions, and safe operating guidelines.

Learning Objectives

The learner will:

- Understand the basic functions and operations of a Kubota tractor.
- Understand the basic safety features and concerns of operating a Kubota tractor
- Learn about the maintenance and long-term care of a tractor and its implements

Understanding the Various Controls on the Tractor

- **Starting the Tractor**
  - The Kubota and most small farm tractors are started by turning the key to the right one click until the light for the glow plugs comes on and then goes off again. You may then depress the clutch and turn the key all the way to the right until the engine turns over.
  - On cold mornings the choke may be required. This is operated by pulling the choke (located near the key) all the way out. As you turn the engine over, slowly push the choke back in until the engine kicks on.
  - It is very important that the throttle be pushed all the way in the upward (turtle) position before starting the tractor. This gives the tractor an opportunity to warm up in the idle position, which is very important for any diesel engine.

- **Throttle Control**
  - The throttle can be located sticking out of right side of the dash. It is an orange handled lever equipped with a turtle and a rabbit symbol.
  - Pulling down on the lever towards the rabbit increases the amount of fuel fed into the engine and therefore increases RPM's and available power to the tractor.

- **Clutch Pedal**
  - This is a single pedal found on the left side of your foot controls.

- **Forward and Reverse Pedal**
  - This "rocker" pedal makes the tractor go forwards and backwards and can be found on the right side of your foot controls. It sits on the floor of the tractor.

- **Brake Pedals**

- These pedals sit above the "rocker" pedal and can be operated as one pedal or split to brake the individual rear wheels.

Understanding the various parts of a small farm tractor and their functions

- **PTO (power take off)**
  - A PTO is used for powering a tiller, auger, or any other implement that is actively driven by the tractors engine.
  - The PTO can be located in the back of the tractor and/or under the tractor between the axels.
  - Hooking up the PTO drive shaft to the PTO and running the engine so the tachometer reads 540 RPMs.
  - To engage the PTO the clutch must be depressed. Once the clutch is depressed you may shift the PTO lever forward and then slowly release the clutch pedal to begin spinning the PTO. The lever can be found next to your right hip on the tractor.
  - It is important when engaging the PTO not to "shock load." A "shock load" happens when the clutch is popped and the engine is revved to a running RPM level. "Shock loading" the PTO stresses the metal on the tractor and the implement being driven. To avoid this, run the tractor's engine with the lowest RPM's possible when taking your foot off the clutch and engaging the implement.

- **Three-Point Hitch Hydraulic**
  - The hydraulic unit and three-point hitch system is designed to raise and lower the implement positioned on the rear of the tractor.
  - The hydraulics are used to determine the operating depth of both active (PTO driven) and passive implements. This will determine the depth of tillage, subsoil ripping, plowing, etc. of any given implement in use.
  - The lever that controls the three-point hitch can be found on the right side of the tractor driver's body around the height of the knee.
  - If the lever is pushed towards the ground at maximum depth the implement will be forced down as far as it may go by the hydraulics of the tractor.

- **Front Bucket Loader**
  - The front bucket loader is used for scooping large loads and moving heavy objects or masses of earth around the farm.
  - The front bucket loader is hydraulically operated using the ball lever located on the right hand side of the tractor directly across from the tractor driver's shoulder.
  - There are two different ranges of motion available to you when using the front loader.
  - The arm of the bucket may be raised or lowered and the bucket may be tilted forward and backward.

- The controls are "reversed" in that to make the arm of the bucket come up, you pull down on the ball lever. To lower the arm, you push up on the ball lever.
- To dump the bucket, you move the ball lever to your right. To tilt the bucket back, you move the ball lever to your left.
- These are the four main movements of the ball lever. Each movement is accomplished by moving the lever in the primary directions (north, south, east and west).
- There are four other movements that incorporate both ranges of motion simultaneously. In other words, they move the arm and the bucket at the same time. These movements can be found by engaging the ball lever at the secondary directions (i.e., southwest, northeast, etc). These movements require more skill and experience and will make your movements more fluid.

Basic Tractor Safety Principles

- Always wear your seatbelt! Most tractors are equipped with a roll over protection device that is built to protect you if the tractor rolls. A seatbelt will save you from getting crushed!
- Never stand near a spinning PTO! The PTO and connected drive shaft spins with incredible force. Keep clothing and body parts away from the spinning shaft, or risk dismemberment and death!
- Do not rest arms or hands in the joints of any hydraulic part!
- Never put your hands inside or around active implements when the tractor is running! Turn off tractor if any jamming or other obstructions occur when using PTO driven implements.
- Do not operate tractor on a dangerous slope! Be aware of rollover dangers.
- Always move very slowly when moving heavy loads in the bucket! Driving with a heavy load greatly changes the balance and stability of the tractor. Heavy loads are prone to tipping and rolling.

Resources

Tractor Safety - http://www.ehs.iastate.edu/occupational/farms/tractor-tips
Implements for Compact Tractors - http://www.lsuagcenter.com/nr/rdonlyres/1b522d98-ae78-4dfa-a258-7f845263bdd8/11557/pub2917tractorimplements1.pdf

NOTES

WEED MANAGEMENT

Learning Objectives

The learner will:

- Understand how to identify and address weed problems
- Learn effective solutions to weed problems to implement before, during and after the growing season
- Understand the pros and cons of different weeding and cultivation methods

Pre-Assessment Questions

- What is a weed?
- How are weeds dispersed?
- What are some benefits of weeds?
- What are some of the characteristics of weeds that allow them to compete so well in cropping systems?
- Why control weeds?

Weed Problems

- Crop competition and its effect on crop yield and quality
  - Nutrient, Light, Water competition
- Interference with harvesting

Weed Benefits

- Enhance soil structure
- Improve soil tilth
- Cycle nutrients
- Provide habitat for beneficial insects
- Improve soil water infiltration

Weed Prevention Strategies

- Improve soil tilth, aeration, water infiltration, and fertility to optimize crop growth and minimize weed pressure
- Thoroughly clean equipment
- Do not allow weeds to propagate
- Germinate weeds, turn them under, transplant = slowly decreasing their seed bank
- Thoroughly compost all imported animal manure, bedding, etc.
- Filter surface irrigation water
- Create buffer zones and keep them mowed
- Work with neighbors to eliminate or minimize the potential for spread of noxious and problematic weeds from adjacent lands

Identification

- Identify most common weeds and examine (star thistle, pigweed, purslane, chicory, wild lettuce, false dandelion, chick weed, grasses, etc.)

Manual Cultivation

- Demonstrate and practice proper techniques with various tools - wheel hoe, stirrup hoe, collinear hoe, etc. Discuss need for follow-up cultivation.
  - Benefits - eliminates weeds, stirs soil and breaks crust (allows for easier penetration of air and water)

Tractor Cultivation

- Most common cultivator tractor models, sweeps, basket cultivators, etc.
- Shallow tillage as an option, other implements

Mulch

- Natural Mulch Options, The Benefits of Mulch, "Earth Mulch," Plastic Mulch

Stale Bedding and Blind Cultivating

- Timing Harrowing or Flame Weeding with weed germination and crop emergence (esp. potatoes, etc.)

Pre-Emergent Flame Weeding

- Timing Flame weeding with crop germination (esp. Carrots and Beets)

Bioextensive Farming Techniques

- Using "Bare-Fallow" periods to eliminate weed seeds in soil

Resources

Create a weed management plan - http://extension.psu.edu/business/start-farming/vegetables/factsheets/creating-a-weed-management-plan-for-your-organic-farm
Sustainable Weed Management - https://attra.ncat.org/attra-pub/summaries/summary.php?pub=479

NOTES

WINTER FARMING

Learning Objectives

The learner will:

- Identify opportunities for winter farming and season extension.
- Receive an introduction to production aids relative to winter farming.

Climate

Crop possibilities vary widely with climate, but generally there are crops that are well suited to winter production in most cold climates (i.e. cabbage family, roots, and greens.)

- Maritime Pacific Northwest climate
    - Good for winter crops, ground generally does not freeze
    - Cool and moist means no irrigation required, but promotes rot and disease
    - Production aids are beneficial
- Colder climates
    - Winter harvest possible with production aides. (see "Production Aids" section of this chapter.)

Winter Harvest Means Summer Planting

- The key to fall/winter harvest is to seed crop in the summer to achieve adequate growth by the end of October.
- Decreasing levels of light in fall will slow plant growth to near dormancy. Growth resumes in late winter when the light levels increase.
- Due to the seasonal lack of light and growth, vegetables harvested from November through March must be mature by the end of October. (The exception is over-wintered crops - see below)
- Growth resumes in late winter when most plants will start to flower. If greens become bitter or roots become woody, crops are past their harvest window.
- Lots of space required. No succession planting is possible after this harvest because the soil is too wet, (or even frozen in northern interior climate zones.)

Over-Wintered Crops

- Planted in late summer for a spring harvest. (An exception to this would be garlic that should be planted in the fall for a summer harvest.)
- Successfully over-wintered crops achieve enough growth by the end of October to survive the cold, possible snow, and lots of rain.
- Growth resumes in late winter and crop reaches maturity in spring.

Production Aids

- Season Extension using farming techniques and/or structures to increase soil temperature or shield crop from extreme weather, which enables steady crop growth, extends later into fall and begins earlier in spring.
    - December and January- lowest light but warmth will aid slower growth
    - Nov, Feb, March – more light and higher outdoor temps mean slightly faster growth

- Warm and sheltered spot
  - South facing slope
  - Windbreak
- Mulches
  - Straw moderates soil temperature; prevents freezing
  - Plastic raises soil temperature
- Low covers
  - Remay or plastic over wire hoops to create a tunnel over a row crop
- Cold frames
  - Low wood frame with glass or plastic over top
- High tunnels
  - Plastic over hoops, tall enough to work in or drive a tractor through
- Greenhouses
  - Permanent, framed skeleton with glass or plastic for roof

Storage Crops

- Grown in Summer, harvested in Fall, stored for Winter use
  - Potatoes- Store @ 35 degrees and high humidity
  - Winter Squash- Store @ 50-55 degrees and dry
  - Onions and Garlic- Store @ 40 degrees and dry

Assessment/Review

- Can you differentiate between the planting and growth schedules of Fall/Winter harvest crops and over-wintered crops?
- Name several ways of extending the season by using production aids.
- What crops are generally well suited to winter production in most climates?

Resources

Four Season Harvest by Elliot Coleman
The Winter Harvest Handbook by Elliot Coleman
http://www.fourseasonfarm.com

NOTES