SMALL HOME VINEYARDS
Need more Information:

Help Desk
Monday, Wednesday, Friday
9:00 AM – 12:00 Noon
253-4143

E-mail: mastergardeners@countyofnapa.org
http://cenapa.ucdavis.edu
What questions do you have for us??

- How many have vineyards?
- How Big?
- What varieties?
- Where are they located?
- Are you aware of Integrated Pest Management (IPM)?
- Do you sell your grapes?
- Vineyard Management (DIY or Professional)
OUTLINE OF WHAT WE ARE COVERING TODAY

• INTRODUCTION – Cindy P (9:30 – 9:40)

• ANNUAL GROWTH CYCLE, BASIC BOTANY AND CALENDAR OF EVENTS IN A VINEYARD - Carolyn (9:40 – 10:10)

Outside (10:10 – 11:10)
• PRUNNING - OUTSIDE – Kendall
• VINEYARD FLOOR MANGEMENT/ COVER CROP OUTSIDE- Kendall
• FROST PROTECTION – Kendall (11:10 – 11:20)
• CANOPY MANAGEMENT – Kendall (11:20 – 11:40)
• PETIOLE TEST REVIEW – Kendall (11:40 – Noon)

LUNCH (Noon – 12:30)
• CROP LEVELS AND THINNING – Dave (12:30 – 12:40)
• VINE NUTRITION AND FERTILIZATION – Dave (12:40 – 1:00)
• IRRIGATION TIMING AND TECHNIQUES – Dan (1:00 – 1:20)
• DROUGHT AND DRY FARMING – Carolyn (1:20 – 1:25)
• POWDERY MILDEW – Dan (1:25 – 1:35)
• INTERGRATED PEST MANAGEMENT-PIERCE DISEASE/EUROPEAN GRAPE MOTH/ MEALY BUGS AND THRIPS – Carolyn/Dan (1:35 – 2:30)
Online Presentation

MG Website  http://ucanr.edu/sites/ucmgnapa/

Our Presentation
CALENDAR OF EVENTS FOR VITICULTURE MANAGEMENT

- HARVEST
- VITICULTURE OPERATION
- PEST MANAGEMENT
Calendar of Events

WEATHER

• Rain
• Or lack of!
• Frost Danger
• Heat spell hazard
• We will be covering this in detail today-
Calendar of Events

HARVEST

• Wine Grapes

  early  (sparkling wines)

  mid season  (whites /pinot noir)

  late  (Cabernet Sauvignon, Merlot)
Calendar of Events

VITICULTURE OPERATIONS

- Shoot removal
- Plant Cover Crop
- Irrigation
- Pre Harvest vine preparation
Calendar of Events

PEST MANAGEMENT

• Insects and Mites
• Nematodes
• Diseases
• Vertebrates
• Weeds
ANNUAL GROWTH CYCLE

-------THREE INTEGRATED CYCLES-------

• VEGETATIVE GROWTH

• CLUSTER INITIATION

• FRUIT GROWTH AND DEVELOPMENT
ANNUAL GROWTH CYCLE

VEGETATIVE GROWTH

• COOL TEMPERATURES – FOR GOOD UNIFORM BUDBREAK
• BUDBREAK
• SHOOT GROWTH
• CARBOHYDRATES
Bud Break - Swollen bud
Bud Break
Bud
Bud Break
Early Shoot Growth
Early Shoot Growth- flat leaf stage
Early Shoot Growth - Six inch Shot
Early Growth-twelve inch growth
Twelve-inch growth stage showing early development of axillary buds
Vine Growth at the beginning of bloom
ANNUAL GROWTH CYCLE

CLUSTER INTIATION

• ALL FORMED IN THE BUD – FRUIT CLUSTER OR TENDRIL
• INFLUENCED BY ENVIRONMENT
• FLOWER CLUSTER FORMED THE YEAR PRIOR
Bloom
Bloom
Bloom in Process
Fruit Set
Bloom Pollination
Bloom Pollination
Bloom Pollination
Fruit Set
Fruit Developing
FRUIT GROWTH AND DEVELOPMENT

• GRAPE FLOWERS ON CLUSTER
• SELF-POLLINATING
• FLOWERS BLOOM 6-10 WEEKS AFTER SHOOT GROWTH BEGINS
• FRUIT SET -20-30% FLOWERS REALLY BECOME BERRIES
Fruit Elements

- Cane (shoot)
- Rachis
- Peduncle
Fruit Fully Developed - Veraison
Underside of Leaf
High Vigor
Fall Leaves
Fall
ANNUAL CYCLE OF GROWTH

FACTORS INFLUENCING GRAPE BERRY GROWTH

• GENETICS
• BIOPHYSICAL CONSTRAINTS
• ENVIRONMENT
• SOURCE/SINK RELATIONSHIPS
• WATER STRESS
BASIC BOTANY

• What factors effect growth and ripening

• Temperature and light influences

• Carbohydrate nutrition

• Understand irrigation, nutrition, ripening and fruit quality
Wine Grapevine Structure

Typical vinifera grape leaf with five lobes

1. petiole
2. leaf blade
3. lateral lobe
4. serrations
5. apical lobe

Cane

1. internode
2. dormant bud
3. node
4. internode
5. lateral shoot

Main features of a grapevine shoot after fruit set

1. cluster
2. leaf petiole
3. leaf blade
4. growing tip
5. lateral bud
Bud

Dormant Grape Bud

- Flower cluster primordia
- Primary bud
- Tendril primordia
- Secondary bud
- Secondary bud
- Leaf petiole
- Cane node
- Pith
Compound Bud
Bloom
TRANSLOCATION

• Movement of carbohydrates, some nutrients and hormones in the plant
• Occurs in the phloem
• Phloem is made up of living plant cells
• Moves upward and downward in plant

• PHLOEM = FOOD

• Sinks- food goes where needed - leaves, berries, roots
Phosphite is systemic, and is easily absorbed through the roots and transported up the Xylem to the rest of the plant.

Phosphite is easily absorbed through the leaves and transported down the Phloem.
Root Growing Point
Photosynthesis

• The process which enables plants to produce their own food

• Energy from sun (light) is transformed into stored chemical energy (sugars, carbs)

• CO2 (carbon dioxide + H2O (water) in the presence of light and chlorophyll >>>>>> simple sugars or carbohydrates + O2

• Only during daylight Influenced by : Light- Temperature- Water status (wind)
Pruning
Objectives of Pruning

• Controlling the size and structure of the vine
• Regulate crop size
• Maintain a balance between vegetative growth and fruiting
  – maximizing the yield potential while maintaining the health of the plant
• Determined by trellis system
Spur

Length of spur is 2 clearly defined buds
Head Trained

Vine with Spur Pruning
Cordon Pruning
Cordon Pruning

- Spur
- Arms, Cordons
- Trunk
Cane Pruning
Bad Examples

Poor spacing of spurs

No sunlight in canopy
Dead shoots
Wrong Spacing
Clusters well spaced
Outside
Frost Protection
Frost Damage

• #1 Cause of weather related economic losses for grape growers
• Freezing causes rupture of cell walls, cells get leaky and get dehydrated.
• Temp less than 32 degrees F (0 C).
Freeze Damage
Frost Damage Occurs Quickly!

• Damage begins with air temperatures of 31 degrees for only ½ hour.
• Temps of less than 30 degrees lasting several hours will kill growing buds in the spring.
• More mature vines do better.
• Optimally hydrated vines also do better.
Passive Frost Protection

Often get you up to 2 degrees (often all needed):

1. Vineyard site selection – cold air is trapped in low areas and moves down a slope.
2. Clean/bare/firm/wet vineyard floor.
3. Plant later budding varietals.
Cold Air Movement
Active Frost Protection

- Overhead Sprinklers – require a lot of water, can get up to 8 degrees of protection.
- Wind Machines – bring warmer air above the vineyard to the colder air at ground level. Good for 1 – 3 degrees protection.
- Heaters – not used much anymore.
- Frost Protection Sprays – (Cloud Cover/Copper)
- Garden Cloths/Lights – works for a few vines.
How Wind Machines Work

During the day:
- Sun heats soil and trees
- The air above the ground is heated by leaves and soil.

Night frost:
- Layers of warmer air + 2°C
- Inversion layer or thermal ceiling
- Difference in temperature 6°C
- Layers of colder air - 4°C
- Trees and soil chilled by thermal radiation.

The effect of the wind machine:
- The wind machine transfers heat by forced convection from the warmer layers (approx. 15 m high) down to the lower colder layers.
FROST PROTECTION
WIND MACHINES
Canopy Management
Canopy Management

It is all about Balance

Shape, Orientation, Location of shoots and Leaves
Canopy Management
Why we do it

For This Year

✓ To maximize wine grape yield, wine quality or both at the same time,

✓ Essential to being consistently successful from one year to the next.

A properly balanced vine, with the right ratio of shoots and leaves to fruit, is the goal, as well as striving for the right fruit exposure to light and maintaining the fruit within an optimum temperature range.
Canopy Management

Why we do it

For Next Year

Two critical elements:

- Production of adequate fruit buds
- Production of sufficient carbohydrate and nutrient reserves for the following year
Canopy Management

What Affects Balance

Vegetative Growth

Fruit Production
Canopy Management

General Crop Load Indices

- 8 Leaves per cluster
- 10 – 14 cm$^2$ leaf area – gram fruit weight
Canopy Management

Know your microclimate, Orientation to the afternoon sun

- **When to Start**
  - Just Prior To or at bloom
  - Increase light on the bloom

- **During rapid shoot growth**
  - Suckers
  - Water spouts
  - May need additional leaf pulling

- **When to stop**
  - Start of Veraison
  - Prior to Harvest
Canopy Management

LEAF REMOVAL TIPS

✓ At the beginning of berry set take off leaves in the fruiting zone to expose grapes to sunlight as necessary.

✓ Be careful of too much leaf removal on the south or western sides because of potential sunburn.

✓ A dense canopy is also conducive to the development of bunch rot or mildew because it prevents the sprays from reaching the fruit. Air movement helps reduce moisture which leads to these conditions.
Petiole Test
Petiole Test

- **When** (At Bloom most common)
- **Which** (Around cluster – opposite)
- **How Many** (75 – 100)
- **Frequency** (Annually)
### Petiole Analysis

**Report of Plant Tissue Analysis**

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**Critical Levels**

- **Deficient**: N 0.1 - 0.7%, NO3-N 100 - 200 ppm, Cl 0.1 - 0.3%, P 0.5 - 1.5%, K 1.0 - 4.0%, Mg 0.5 - 1.5%, Ca 1.5 - 4.0%, Na 0.1 - 0.5%, Fe 0.5 - 1.5 ppm, Al 0.2 - 0.5 ppm, Mn 2.0 - 5.0 ppm, B 0.1 - 0.5 ppm, Cu 0.1 - 0.5 ppm, Zn 0.5 - 1.5 ppm
- **Marginal**: N 0.8 - 0.3%, NO3-N 200 - 400 ppm, Cl 0.4 - 0.6%, P 1.6 - 3.0%, K 4.0 - 6.0%, Mg 3.0 - 4.0%, Ca 4.0 - 5.0%, Na 0.5 - 1.0%, Fe 1.5 - 2.5 ppm, Al 0.6 - 1.0 ppm, Mn 5.0 - 7.0 ppm, B 0.6 - 1.0 ppm, Cu 0.5 - 1.0 ppm, Zn 1.5 - 2.0 ppm
- **Adequate**: N 1.2 - 1.6%, NO3-N 400 - 600 ppm, Cl 0.6 - 0.8%, P 3.0 - 4.0%, K 6.0 - 8.0%, Mg 4.0 - 5.0%, Ca 5.0 - 7.0%, Na 1.0 - 1.5%, Fe 2.5 - 3.5 ppm, Al 1.0 - 1.5 ppm, Mn 7.0 - 9.0 ppm, B 1.5 - 2.0 ppm, Cu 1.5 - 2.0 ppm, Zn 2.0 - 3.0 ppm
- **Excessive**: N 1.8 - 2.2%, NO3-N 600 - 800 ppm, Cl 0.9 - 1.1%, P 4.0 - 5.0%, K 8.0 - 10.0%, Mg 5.0 - 6.0%, Ca 7.0 - 9.0%, Na 1.5 - 2.0%, Fe 3.5 - 4.5 ppm, Al 1.5 - 2.0 ppm, Mn 9.0 - 11.0 ppm, B 2.0 - 2.5 ppm, Cu 2.0 - 2.5 ppm, Zn 3.0 - 4.0 ppm

**Crop Type**

- **Wine**: Excessive
- **Grapes**: Excessive

For more details, contact [Jasmin Cardone](mailto:jasmin.cardone@sample.com).
Lunch
Crop Levels
Over cropping

• Over cropping = having too much fruit on the vine to ripen

• Balance of the canopy to the fruit enough canopy for photosynthesis to ripen the fruit

• Too much vegetation can result in undesirable flavors in the wine.
Crop Thinning

- In June after berry set, remove bunches over two per cane.
- If there is shatter or poor set, leave 3 bunches per cane.
- If the crop is especially heavy or the variety produces large bunches, the bunch arm can also be removed.
Crop Levels and Thinning

BUNCH THINNING

- After veraison (coloring) review crop loads
Crop Levels and Thinning
Vine Nutrition and Fertilization
Grapevine Nutrition
What’s Needed for Healthy Growth & Development

Macronutrients

Primary
- Nitrogen
- Phosphorus
- Potassium

Secondary
- Calcium
- Magnesium
- Sulfur

Micronutrients
- Iron
- Manganese
- Molybdenum
- Copper
- Zinc
- Boron
Nutrient Requirements

Five critical questions to ask for proper grapevine nutrition.
• Which nutrients are required by the vine?
• What’s the function of each nutrient?
• At which physiological stage is the nutrient mostly required?
• When should I fertilize?
• How much fertilizer should I apply?
When is the Nutrient Required?

Nutrients have different functions and are required during different times of the season.

Most common periods for fertilizer applications are:

- After bud break
- After fruit set
- After harvest
- Foliar applications through the growing season
When is the Nutrient Required?

- Macro elements (N, P, K, Ca, Mg) should be applied to the soil for uptake by roots
- Micro elements (B, Zn, Mn, Fe, etc.) are required in small amounts and can be applied through foliar sprays
- Applications of macro elements should be during periods of active root growth
  - After bud break
  - After harvest
- Applications must be done with irrigation to ensure infiltration to the root zone
All Nutrients are not Created Equal

The Nutrients we Really Care About:
- Nitrogen
- Potassium
- Magnesium
- Boron
- Calcium
- Zinc

The Nutrients we Somewhat Care About:
- Phosphorus
- Iron
- Manganese
- Molybdenum
Grapevine Nutrition Assessment

Visual - Abnormalities of the plant – trunk, stems, leaves, fruit.

*Phosphorus*  
*Potassium*  
*Nitrogen*
Grapevine Nutrition Assessment

Soil Test - Reflects the nutrient content present in the soil but not necessarily available to the plant.

- Normally done before planting.
- Not normally done after planting unless visual symptoms indicate a problem.
NUTRIENTS WE CARE ABOUT
Nitrogen (N)
Essential to fruit development. Helps improve leaf quality so the grapevine can better convert sunlight into nutrients.

Phosphorous (P)
Helps roots grow deep and strong and ensures the grapes will develop sufficient sugars to be sweet and succulent when ripe.

Potassium (K)
Works to build a healthy vine, helping it resist disease. Also helps the vine grow higher-quality grapes.
Nitrogen

Too little – pale green color, weak canopy growth, lower yields.

**Good Leaf**

**Bad Leaf**

Too much – excessive vigor, fruit shatter, delayed fruit maturity.
Phosphorus

Deficiency: rare in Napa. Usually found in soils with very low or very high pH or originated from volcanic ash.
Potassium

Deficiency: usually found when grapevines have been heavily cropped. Shallow, poorly drained soil and water stress contribute.
Boron

- Essential for plant growth and development.
- Small window between deficiency and toxicity.
- Only a small amount is needed (.4 ppm to 1.0 ppm is toxic).
- Deficiencies occur usually in early spring drought or later in the season with a soil deficiency.
- Toxicities can occur in Napa as we have high levels in soil & water.

**Deficiency**

**Toxicity**
Calcium

- Important in organs (shoots, leaves, roots), especially leaves
- Constituent in cell membranes, permeability of cell membranes
- Important for survival during dormant period
- Strength of berry skins
Zinc

- Essential for plant protein synthesis, the production of some plant hormones and in pollination and fruit set.
- Deficiency causes distortion of leaves as well as interveinal chlorosis.
FERTILIZATION
Fertilization Guidelines

• Before applying an ounce of fertilizer STOP and ask “why am I doing this?”
• There is no recipe for nutrition management.
• Low to moderate fertility can improve wine quality.
• Multiple applications are better than a single large one.
• Soil treatments are usually more durable than foliar.
• Foliar feed micronutrients and soil treat the macronutrients
• Most fertilizers, soil and foliar, are best applied between fruit set and veraison, with the exception of Boron and Zinc.
• Don’t pollute. Manage nutrients as you would pesticide.
Fertilization Calendar

December, January & February
• Apply boron spray to soil beneath vines if petiole analysis indicates need.
• Apply zinc sulfate to vine cuts if there are indications of need.

March, April & May
• Mow cover crops
• Apply pre-bloom zinc and boron foliar spray. Usually mixed with wettable sulfur.
• Send petiole samples to laboratory for tissue analysis.

June, July & August
• Apply potassium sulfate, if petiole test shows need.
• Apply organic fertilizer or compost directly beneath drip emitters after bloom.
Irrigation Scheduling and Maintenance
When and How Much

Water Use

Vine Use

Water Supply

Irrigation

In-Season Rain

Soil Stored Water
Vine Water Use

- **Transpiration** = water loss by plants through their stomata.

- **Evaporation** = Water loss from the leaf surface

- **Evapotranspiration** relates to the rate of water use. It includes the evaporation of water from the soil surface and the movement of water from the soil through the plant and out through the leaves.

- Vines are drought resistant plants. Water only when necessary.

- The best thing is to know your plants: make visual assessments
When to begin

During rapid shoot growth

Growing Season

Shoot Length influenced by water deficits

Shoot tip condition

Test Soil Moisture

Visual Assessments

Tendril Health

Internode Length

Test Soil Moisture
How Much

Know your microclimate

• Each vineyard can be very different in location (climate), soil-water capacity, vigor and trellis design.

Production Goals

• Variety and wine program to which the fruit is destined.
Know your soil

Soil Texture affects water-storage capacity

<table>
<thead>
<tr>
<th>Textures</th>
<th>Holding Capacity</th>
<th>Irrigation Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>Loamy</td>
<td>More</td>
<td>Less</td>
</tr>
<tr>
<td>Clayey</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How Much

New Vines – First Year

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>First Six Weeks</th>
<th>Second Six Weeks</th>
<th>Remainder of Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy</td>
<td>1.5 Gals/per Day</td>
<td>1.5 Gals/2\textsuperscript{nd} Day</td>
<td>1.5 Gals/3\textsuperscript{rd} Day</td>
</tr>
<tr>
<td>Loamy</td>
<td>1 Gal/ per Day</td>
<td>1 Gal/2\textsuperscript{nd} Day</td>
<td>1 Gal/3\textsuperscript{rd} Day</td>
</tr>
<tr>
<td>Clayey</td>
<td>.75 Gal/per Day</td>
<td>.75 Gal/2\textsuperscript{nd} Day</td>
<td>.75 Gal/3\textsuperscript{rd} Day</td>
</tr>
</tbody>
</table>
# How Much

## New Vines – Second Year

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>June 1* - Six Weeks</th>
<th>July 15&lt;sup&gt;th&lt;/sup&gt; until October</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy</td>
<td>1.5 Gals/3&lt;sup&gt;rd&lt;/sup&gt; Day</td>
<td>2.5 Gals/5&lt;sup&gt;th&lt;/sup&gt; Day</td>
</tr>
<tr>
<td>Loamy</td>
<td>1 Gal/3&lt;sup&gt;rd&lt;/sup&gt; Day</td>
<td>2 Gal/5&lt;sup&gt;th&lt;/sup&gt; Day</td>
</tr>
<tr>
<td>Clayey</td>
<td>.75 Gal/3&lt;sup&gt;rd&lt;/sup&gt; Day</td>
<td>1.5 Gal/5&lt;sup&gt;th&lt;/sup&gt; Day</td>
</tr>
</tbody>
</table>

* Start time can vary based on rainfall
When we talked about irrigation for this workshop:

- It depends on:
  - the weather
  - the soil
  - the spacing
  - the rootstock....
When

**Bloom to Verasion**
- Irrigate as needed to continue development of canopy
- Active growth slows down approaching verasion

**Verasion to Harvest**
- Irrigate to maintain canopy, but not encourage growth
- Too much water can deprive roots of oxygen
- Encourages bunch rot give a vegetate flavor to the fruit from too much canopy
Finding Balance

Excessive shoot growth recognized by:
  – Large leaves
  – Long internodes
  – Excessive lateral shoot growth

But – watch weather conditions, dig to determine moisture soil levels
• Don’t Overly Stress vines – Shriveling and yield reduction
• Consider watering to “hang” the fruit until harvest ripeness
Post Harvest

• Irrigate to maintain the foliage for carbohydrate accumulation during the fall.
• 4-8 hours. Drip irrigation

• DO NOT water when plants are dormant
Where - Established Vine
Where - Young Vine

Do not stress new vines
• We may need to start prior to bloom

• Check soil moisture levels now

• May need to adjust crop load to available water

• Dry Farming assumes rain!

• Dry farming is typically implemented over a number of years after vines are established
Powdery Mildew

*Uncinula necator* 2015

POWDERY MILDEW DISEASE CYCLE
chasmothecia are produced on leaves, shoots, and berries in late summer

chasmothecium

ascus containing ascospores

survives on bark

ascospores are released during spring rains

bud scale infections give rise to occasional infections on new shoots in spring

fungus overwinters under bud scales

mildewed grape wood shows reddish brown blotches during dormancy

fungus strands grow on outside of tissue

during spring, powdery white patches appear on leaves

spores infect young grape tissue

secondary infections on young leaves, shoots, and berries

fruits become infected in late spring
Initial Infection
Powdery Mildew
Heavy Mildew Infection
Figure 21.8 Scarring on canes resulting from shoot infection
**MANAGEMENT**

**FUNGICIDES**
- Sulfur – actually a protectant, won’t kill an active infection but prevents new infection.
- Oils – kills fungal colonies (includes horticultural oils (i.e.: Saf-T-Side Spray Oil, Neem oil, Jojoba oil etc.)
- Synthetic Fungicides
- Other – biologicals, etc. (i.e.: Serenade)

**CULTURAL PRACTICES**
- Adequate trellis system/training
- Shoot thinning/leaf removal
- Appropriate hedging
When Do You Spray?

Commercial/Sophisticated Approach:
• UC Davis Powdery Mildew Risk Index Model
• Weather Station

Small Home Vineyard Empirical Approach:
• Start spraying at bud break/continue approx. every 2 weeks until grapes get to 12 Brix. Vary interval by temp/humidity.
Spray Residue/Damage
Integrated Pest Management
Integrated Pest Management (IPM)

• Prevention
  – Correct plant in correct place
  – Maintain tree & garden health (correct watering, fertilization, pruning, and sanitation; balanced eco-system)

• Minimize and Target Intervention
Vine Mealybug

Vine mealybug, Planococcus ficus, honeydew and white wax on infested grapevine after mechanical harvest. *Photo by Larry L. Strand.*
Grape mealybug
Grape, Obscure, and Vine Mealybug

Figure II. Reddish orange fluid excreted by grape mealybug (photo: JKC).

Figure III. Clear fluid excreted by obscure mealybug (photo: Kent M. Daane).

Figure IV. Vine mealybug colony in the axils of the petiole and cane (photo: Mark Battany).
Leafroll  Redblotch
European grapevine moth
Sharpshooters
Sharpshooters
Pierce’s disease
Mites
Eutypa
Vertebrate pests
Vertebrate pests

• Birds
  – COVER THE AREA
Vertebrate pests

- MANAGEMENT
  - Protective Netting
  - Frightening Devices
  - Shooting
  - Trapping
  - Repellents
Vertebrate pests

- Deer Proof the area
  Chicken Wire on Ground
Gophers

Adult pocket gopher, Thomomys species.

Types and brands of gopher traps include (clockwise from upper right) Victor Black Box, Macabee, Gopherinator, and Cinch.

Top view of a pocket gopher mound.

Top view of a mole mound.
Vertebrate Pests - Rabbits

- **Jack**
  - Prefer open to semi open areas
  - 3 – 7 pounds
  - Long black-tipped ears
  - Breed – Jan – August
    - 2 – 3 /litter
    - 5 litters/year

- **Cottontail**
  - Prefer dense cover, bushy areas
  - 1 ½ - 3 pounds
  - Rounded shape
  - Breed – Dec – June
    - 3 – 4 /litter
    - 6 litters/year
Vertebrate pests

- Rabbit Management
  - Rabbit Resistant Plants
  - Exclusion
    - Fencing
    - Trunk Guards
Vertebrate pests

- Rabbit Management
  - Trapping (cottontails)
    - Box plus conibear trap

- Rabbit Repellents
  - Chemical with unpleasant taste
  - Application before damage
    - Reapply often
    - Not for plants intended for human consumption
VOLE DAMAGE- girdled trunk
Thank you for your time!

Our Next Workshop: Part 2 – August 20th

Plant Sale – April 23rd

Please complete our course evaluation