Potatoes, Root Crops, Weed Management and Limited Insect Control
Potatoes

- Most ! & most widely grown vegetable in the world.
  - 130 countries
  - Adaptable
    - Below sea level, Netherlands - 14,000 ft in Andes
    - Arctic Circle – Tierra del Fuego in the South
    - Arid climates of Australia & Africa
    - Not in tropical jungles-temperature too high and humid.
  - Fresh Market & processing
    - Chips, dehydrated, canned, frozen,
    - Used for starch & flour
    - Livestock feed
    - Production of vodka, paste & dyes
    - Fermented into ethyl alcohol & mixed with gasoline
Wild Tubers---Potatoes (Solanum tuberosum) relative of tomatoes, eggplant, peppers, tobacco, petunias – Nightshade family 160 species form tubers.
Emergence & early development

- Seed piece—last year's potato
- Shoots emerge—grow 3.5 ft.
- Roots grow sideways, then down, most in top 24 inches.
- Flowers: white to purple produce small green berry contains up to 30 seeds that genetically vary & not used in production.
- Potato Tubers = emerge as the thickened or enlarged portion of underground stem—a stolon usually at the distal end or tip.
The Tuber

- is a storage organ and consists of stored or surplus food materials, mostly carbohydrates that are in excess of those needed by the plant for its normal growth.

- Have all the characteristics of normal stems, including nodes, which are marked by the presence of buds or “eyes”.

Shoot/Tuber Relationship

The yield & quality of tubers is directly dependent on an abundant supply of carbohydrates furnished by the foliage to the tubers.

- Early in season vigorous shoot growth desirable—build up photosynthetic surface for tuber development later in season.

- After tubers are initiated they are in direct competition for carbohydrates with other parts of the plant.
  - Since other parts like the leaves are closer to the source of carbohydrates, the tubers get the leftovers.
    - Important healthy strong nutritionally sound plant.
Temperature & Daylength

- Play a big role in yields of potatoes
- Optimum tuber production is 60-65°F with maximum average temperature of 75°F and minimum of 45°F.
- High day or night temperatures increase respiration rates causing a decrease in the supply of carbohydrates to the tubers.
- Long days promote vine and stolon growth. Greatest at 77°F.
- Tuber initiation is favored by short days, bright sunlight and moderately low temperatures 59°F.
Planting & Crop Establishment

- Soils = silt loams, sandy loams, peat or much soils.
- Soil pH = 5.4-7.0 usually closer to 5.0 if variety is susceptible to scab.
- Among the vegetables with the highest fertility requirements – 180 lbs. N.
- No manure the spring of seeding = scab problems.
Green Sprouting

- Accelerates plant emergence and speeds the development of tubers. 7-14 days earlier
- Certified seed only
- Place the “B” size tubers in shallow trays, no more than 2 deep. Stack in corner of greenhouse, trying to avoid extreme high temperatures, 70F. until tubers sprout usually 10-14 days.
- Tubers may be cut into pieces
- Warmed for several days before planting if not green sprouted to avoid decay.
Planting

- Soil preparation: Band recommended fertilizer at time of seeding.
- Drop seed 6-8 inches apart, cover with 2-3 inches of soil, 1 lb. of seed per 6 feet.
- Cover with row cover, no hoops.
Hill & Cultivation—6 inches high and sidedress. Prevent Greening and cultivate as little as possible
Irrigation

- Very High water requirement
- Plants are shallow rooted
- During heavy vine growth potatoes need about 2 inches per week.
- The period of stolonization and tuber initiation is critical.
Different Varieties Excellent Markets and Price
$2.00 per pound
Satina: German variety resistance to rhizoctonia, scab and follow heart. Field resistance to late blight.
Sifra White    Red Gold
Colorado Beetle Larvae Damage on Eggplant
Insects

- **Colorado Beetle Larvae Damage on Eggplant**
- **Must be controlled but only limited.**
  - Potatoes can withstand 15% defoliation
- **Rotate to nonhost crops—overwinters in the field.**
- **Scout the field IPM**
- **Alternate groups of insecticides.**
- **Bts are effective but timing must be right**
- **Use mechanical barriers**
  - Plastic lined trench traps
Integrated Pest Management (IPM)

- Coordinated use of pest and environmental information to design and implement pest control methods that are economically, environmentally and socially sound.
- Promotes PREVENTION over Remediation
- Advocates the use of multiple control strategies to achieve long-term pest management solutions.
- INFORMING FARMER / information gathering Education
IPM: Before We Spray

- **Accurate Pest Identification:**
  - Crucial first step
    - Abiotic vs Biotic
      - Disease, Insect, Nutritional problem
  - Contact Ann Hazelrig, Vt. Plant Diagnostic Clinic

- **Biology and Life-cycle of pest:**
  - For example: Colorado Potato Beetle or Magnesium deficiency in Tomatoes

- **Scouting:** regular inspection of crops
  - for damage on cabbage.

- **Monitoring:**
  - weather for conditions conducive of disease
  - Trapping pest: use some kind of pheromone to lure adult moths or sticky card to catch and determine thresholds.

- **Action Thresholds:** reach certain levels before spraying

- **Proper Record Keeping:** History of useful information.
Beyond Information Gathering: Preventative & Curative Control Methods

- **Cultural Controls** are modifications of the crop production system.
  - Crop rotation: Frequently alter the habitat, type & timing of food supply available to pest.
  - Sanitation: remove habitat & inoculum by destroying crop residue
  - Modifying planting times or plant spacing
  - Nutrient management & Irrigation to optimize crop health

- **Mechanical & Physical controls** consist of using some factor to disrupt pest life cycles or suppress populations:
  - Hot-water-treated seed
  - Flaming show video
  - Row covers to modify crop environment: flea beetle, cabbage maggot both in brassicas
  - Roguing infected plants

- **Genetic Controls**: traditional breeding programs or biotechnology
  - Resistant varieties

- **Biological Control**: the use of naturally-occurring or introduced beneficial organisms to control or suppress pest populations:
  - Natural enemies of pest exist everywhere in nature and should be preserved whenever possible.
    - Parasitic wasps—Trichogramma lay their eggs inside the eggs of pest.
    - Competitive Fungi & bacteria = Bt or Trichoderma harzianum

- **Pesticides**: Only if and when pest populations densities will cause significant economic damage.
  - Use in conjunction with above methods
  - Use “Selective” insecticides. Avoid “Broad-Spectrum” insecticides which kill many different kinds of pests and beneficial organisms.
Tim’s Pest Problems

❖ Potatoes & Eggplant:
  ➢ Colorado Potato Beetle: 1-2 sprays of Bt, Spin Tor (bacterium) or one spraying of a synthetic pesticide.

❖ Cucurbits:
  ➢ Stripped cucumber beetle: Pyrethrins OMRI approved. I use one spraying pre-bloom of Sevin

❖ Brassicas:
  ➢ Imported Cabbage Worms: Bt usually 3 times during the season. Some crops get two sprayings

❖ Tunnel Tomatoes:
  ➢ Leaf Mold:

❖ **NO PESTICIDES:** Beans, Beets, Carrots, Sweet Corn, Garlic, Herbs, Leeks, Lettuce, Mesclun, Onions, Peas, Peppers, Radish, Spinach
Pesticides

- **Pesticide Classification can be based on:**
  - Types of Pesticides based on organisms the pesticide kills:
    - Insecticide
    - Fungicide
    - Herbicide
  - Range of species they affect:
    - Broad-spectrum: kill a wide variety of pests.
    - Selective: narrow set of species
  - Contact or non-contact materials: do they have to be applied directly to the pest—on the insect or the weed or not?
  - Pesticide license is required = restricted use vs. general use.
Pesticide Toxicity

Several Methods for understanding a pesticide's relative toxicity:

- Every pesticide has a “signal word”
  - “Danger” = most toxic group
  - “Warning” = next most toxic group
  - “Caution” = least toxic group

- The Median Lethal Dose, or LD50 value of a pesticide measured in milligrams to kill half the population of test animals.
  - LD50s indicate the acute toxicity of a pesticide as a result of ingestion or contact with the skin.
    - The lower the LD50 value the more toxic the pesticide.

- Other important measures of toxicity measure:
  - Relative risks to birds, fish & bees
  - Carcinogenicity
  - Capacity to cause neurological injury
Requirements for Pesticide Use

- Pesticide label is the legal document which governs pesticide use.
  - Instructions
    - Application equipment
    - Rates or amounts of pesticide
    - Frequency
  - Personal protection requirements during application
  - REI “restricted-entry interval length of time that farm workers must wait before going into a field after the pesticide is applied.
  - DTH “Days to Harvest: the length of time that must pass before a crop can be harvested after the pesticide is applied."
Biorational Pesticides

- Pest control materials that are relatively non-toxic to people with few environmental side-effects are sometimes called “biorational” pesticides.
- May be approved for use on certified organic crops or may not
- Major categories of Biorationals are:
  - Botanicals: Pyrethrin – chrysanthemum broad spectrum insecticide. OMRI (Organic Materials Review Institute)
  - Microbials: formulated microorganisms
    - Bacteria = Bacillus thuringiensis (Bt) for use with Brassicas
    - Fungi = Beauvaria bassiana for use with potatoes to kill CPB
  - Minerals and synthetics
    - Insecticidal soaps (fatty acids of potassium salts)
    - Sulfur and copper compounds = organic fungicides
Carrots

- Belongs to the parsley family (Umbelliferae)
- Historically used primarily for medicinal purposes
- Food crop 16th century
- Purple roots first
- Afghanistan center of origin
- Excellent source of Vitamin A, & good source of vitamins B1, C, & B2.
The carrot is a biennial that is grown as an annual for its root which accumulates starches and sugars. The edible root is actually an enlarged taproot. The root system extends 30-36 inches. Cool season crop prefers temperatures between 59-65F.

- Temps. increase = roots become shorter & less tapered.
- Temps. Decline = roots tend to become long & pointed.

Soils should be deep, loose, well-drained sandy loams. Fertility requirements are relatively modest 50-150 lbs per acre depending upon soil type.

I do not apply manure in year of seeding because the liquid portion of manure apparently stimulates branching of the roots.
Sweetness

- High-quality carrots are those with a relatively large outer core, phloem, since sugars are higher in the phloem than in the inner core, the xylem.

- Carotene, the constituent that gives carrots their characteristic orange color & vitamin A is higher in the phloem than the xylem.
Seeding & Crop Establishment

- Carrot plantings are directly seeded using pelleted seed for better stand.
- Carrots are slow germinators:
  - 50 F = 17 days
  - 59 F = 10 days
  - 68 F = 7 days
- Use row covers on first seeding.
- Sow seeds 30 seeds per foot, ¼ “-½ “deep, in 2 inch row using a scatter shoe. (I don’t.)
- Try to keep soil moist with irrigation until germination-prevent soil crusting which inhibits germination.
- Thin carrots to stand ¾ “ – 2 “ apart depending upon the size desired or use fresh market or processing/storage.
  - Sell our thinnings as baby carrots
- 6 seedings from mid-April to mid-July about 2-3 weeks apart.
Cultivar Choice: Nantes known for their sweetness; Imperator known for shipping; Specialty Markets
Cultivation & Irrigation

- Basket 2-3 times
- Handweed 2-3 times
- Labor Intensive crops
- Herbicides used often—we do not

- Water requirements are about 1 inch per week. Avoid cracking of roots by irregular irrigations.
Weed Control Techniques

- **Weed Prevention techniques:**
  - Rotate among crops with different tillage practices
  - Compost animal manures to kill weed seeds
  - Clean farm implements before traveling between fields
  - Control weeds in hedgerows, alleys, and ditches
  - Mow or cultivate weeds before they set seed.

- **Weed Suppression techniques:**
  - Mulch with plastics or organic residues
  - Stale Seed Bed
  - Grow smother crops or intercrops
  - Hand-hoe
  - Tractor cultivation
  - Chemical control
  - Flame weed
Disease

- **Alternaria or Leaf Blight** = soil borne fungal disease that infects wet foliage, causing dead spots on leaves which slowly kills the leaves leaving only the roots. It is very serious during the fall when warm days and cool nights favor the disease.

- Control is by early application of fungicide
  - Some differences in cultivars
Insects

Black Swallow Tail Caterpillar

let them eat not too many of them
Harvest & Storage

- By Hand, loosen with a fork, 10 carrots to a bunch, wash with hose. Tops are left on for stand sales although transpiration or water loss through the top continues.

- Tool that undercuts the carrots, loosening them, harvested by hand, topped and wash in carrot drum which tumbles etc.

- Mature topped carrots may be stored at 32 F with 98-100% relative humidity for 7-9 months.
  - No apples or pears ethylene gas is given off causing bitterness in carrots
Under Cutter Blade
Beets
Classification & Plant Growth

- Beets (Beta vulgaris) along with spinach and Swiss chard belong to the goosefoot family (Chenopodiaceae)
- Herbaceous biennial grown as an annual for its leafy top and storage root.
- Edible portion of the root consists of alternating circular bands of conducting (light colored) and storage tissues (dark colored) known as zoning.
- Cool season crop that tolerates mild frosts
  - Prefers growing temps of 55-70 F.
- Nutrient demands moderate 100-130 lb. N.
  - DON’T use manure in year of seeding b/c of scab problems
  - HIGH users of micronutrients especially Boron
Seeding & Cultural Practices

- Direct seeding is the usual method of propagation. A few farmers will use transplants for first crops.
- The seed is really a dried fruit with 2-6 seeds within it.
- This seedball is seeded 0.05-1.0 inches deep in rows 12-24 inches apart, 15 seeds per foot. May sow thicker and thin for greens to 2 inches apart.
- Treat the crop similar to carrots with respect to irrigation, cultivation, insect & disease control, row covers and harvesting.
# Herbs

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<th>Herb</th>
<th>Transplanted</th>
<th>Seeded</th>
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<tr>
<td>Basil</td>
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<td>June, July</td>
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<td>Late April</td>
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<tr>
<td>Thyme</td>
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