Sustainable Vegetable Gardening Part 3
Planting - Starting from Seed

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Sustainable Gardening

- Environmentally sound
- Locally/garden-derived renewable resources
- Manage ecological and biological processes
- Acceptable nutrition, protection from pests, disease
- Reduced reliance on external input (chemical, organic)
- Conservation of non-renewable resources (soil, energy, minerals)

Scientific systems approach: understand the parts, how they work, the connections and dependencies among them, and harmonize them. Depends on feedback mechanisms.

Recommended Practices

- Improve compacted soil by aerating, double digging
- Test the soil to learn the pH and nutrients already present
- Use cover crops/green manures to improve soil nutrients and structure
- Rotate crops to avoid the build up of pathogens and pests in the garden
- Determine soil drainage capacity before planting
- Utilize companion planting/intercropping to attract beneficial insects and to take advantage of symbiotic biochemical and cultural benefits
- Practice right plant, right place, in order to take advantage of garden microclimates- hot areas, light angles and moisture sinks, when planning your garden layout.
- Identify insects (friend or foe), diseases or weeds and susceptible life cycles and evaluate the extent of the problem before taking remedial action (using the least toxic alternative).
- Select cultivars of plants and seeds that are bred for resistance and tolerate local conditions; select open pollinated varieties to save seeds and improve plants

Overview

- Seed and seedling biology
- Show and tell
- Propagation
  - Facilities
  - Media
  - Containers
  - Problems
- When to start seeds

Sexual Propagation

- Germination and growth of seeds created in previous generation through fertilization of plant ovary via the union of male and female sex cells. Results in a genetically unique plant generation.

- Types of plants grown from seed: annual, biennial, perennial.

- Open pollinated – parent plant fertilized by another member of same population: + genetic diversity, can be produced and saved, will grow true-to-seed – may not match hybrid performance

- Hybrid – product of two different lines. Resulting seeds are heterogeneous: + uniform characteristics – difficult for growers to produce and save seed.

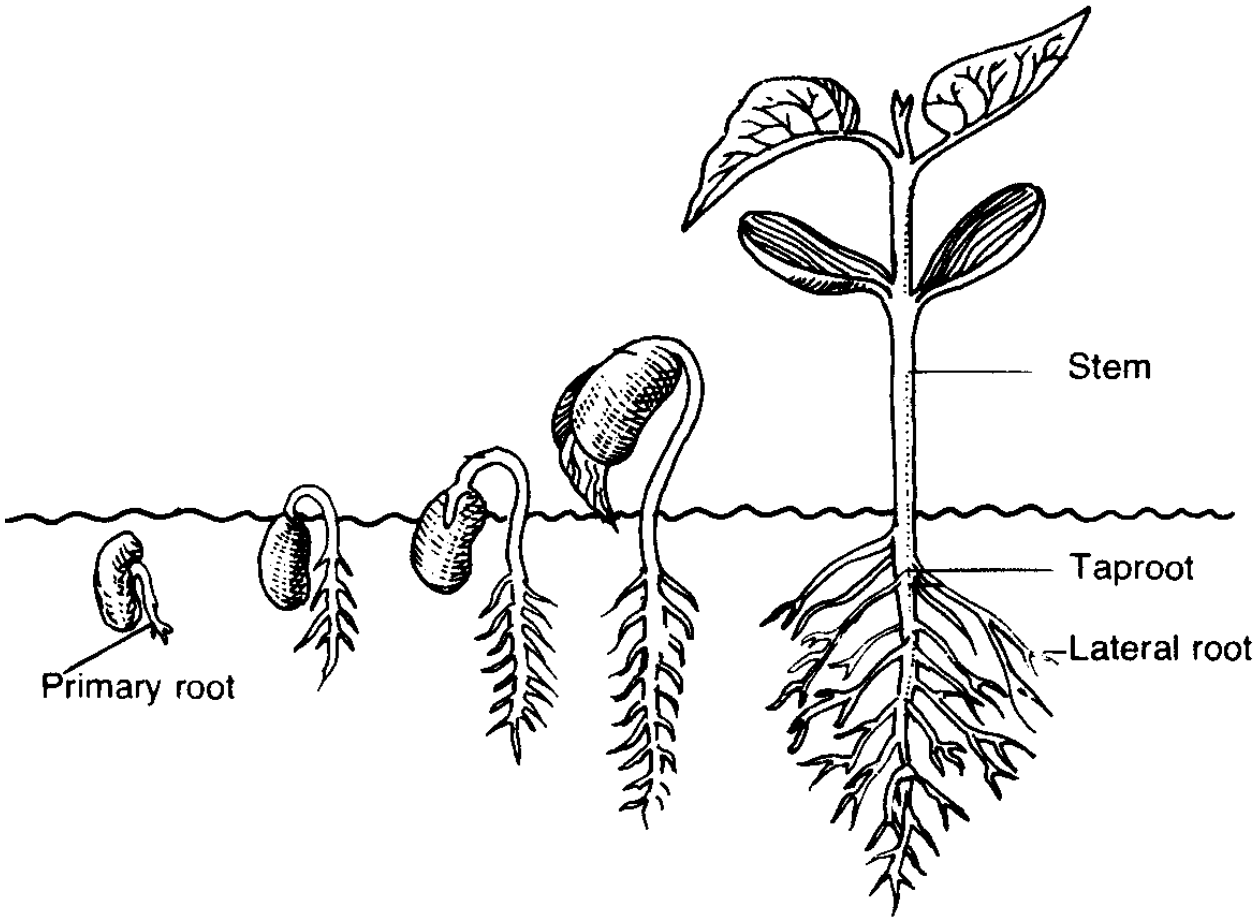
Essential Factors in Germination

- Viability – seed must contain living, healthy embryonic tissue
- Physical and chemical dormancy factors must be broken to facilitate germination
- Temperature conditions: min, max, optimal
- Moisture: delivered through soil media by capillary action to initiate metabolic processes. Fine firm texture for good seed-to-soil contact.
- Aeration: to allow for Oxygen and CO2 exchange
- Light: Most (not all) germinate best in dark, but all require “sunlight” for photosynthesis

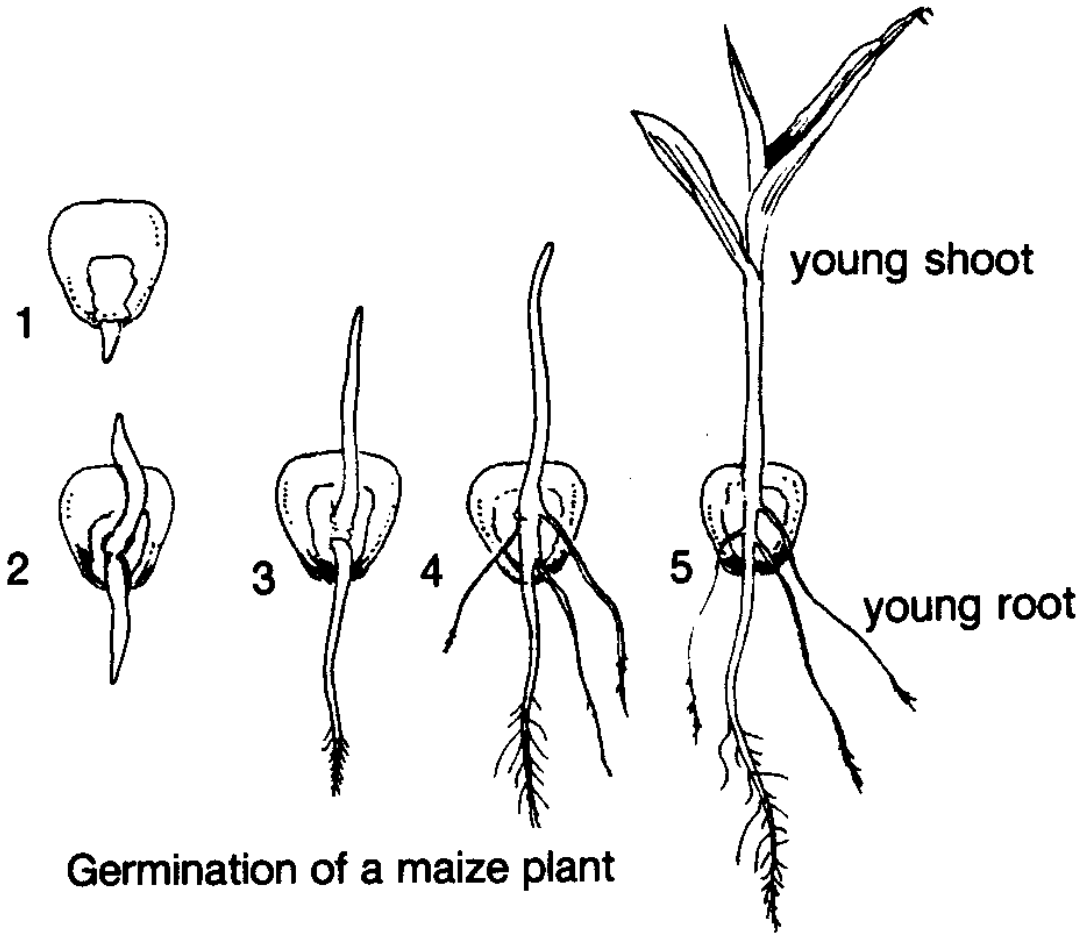
Germination Process

- Phase 1 – rapid uptake of water by dry seed, softening and swelling seed coat
- Phase 2 – activation of mitochondria, protein syntheses, metabolism of stored reserves to fuel development, enzyme production-syntheses, loosen cell walls
- Phase 3 - Root radical emergence, cell enlargement, elongation, cell division

Germination of a bean



Germination of corn



Germination of a maize plant

Early Seedling Development

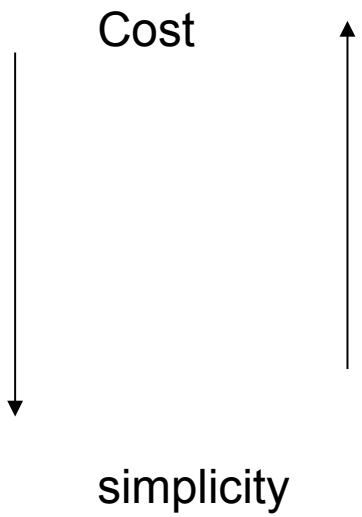
- Continued extension of root
- Emergence of growing point of shoot
- Cotyledons (or epicotyls) raise above ground
- Weight of seedling increases, storage tissue decreases
- Respiration and water uptake increase, elongation of roots and shoots
- Branched root system develops
- True leaves develop and effective photosynthesis begins

Managing Environmental Conditions

- Germination: maintain temperatures within ranges; promote air circulation; frequent, shallow irrigation
- Seedling development: maintain temperature, promote air circulation, decrease frequency and increase depth of irrigation, availability of light becomes critical
- Maturation and hardening off: (3 days to 2 weeks)
  - Expose to day-night temperature fluctuation (carbo reserves)
  - Natural air circulation (thickens cell walls)
  - Moisture delivery less frequent and deeper (promotes roots)
  - Exposure to light of field conditions build strength, decrease likelihood of transplant shock

Types of Propagation Facilities

- Active enclosed greenhouse
- Passive solar greenhouse
- Open hoophouse / quonset hut
- Bedroom window, basement with fluorescent lights
- Cold frame, hot box
- Outdoor benches



Propagation Facilities

- Advantages:
  - Control environment: temp, air circulation, moisture
  - Optimize growing conditions
  - Efficiency: yield, space, water, bed space
- Disadvantages:
  - Cost and labor higher
  - Total time for transplants usually longer
  - Density or plants increase risk of crop damage
  - Greater use of non-renewables: plastic, styrofoam, mined resources, fossil fuels

Starting Facilities

Celery and parsley in a cold frame

Onion seedlings in a green house

Double dug beds in greenhouse

Growing Media

- Provide idealized environment: air, water, nutrients, structure (pathogen free and resistant)
  - Nutrients: compost, soil, organic and mineral amendments
  - Drainage: sand, perlite, compost, vermiculite, peat moss, leaf mold
  - Moisture retention: compost, peat moss, coir fiber, vermiculite, leaf mold
  - Aeration: perlite, sand, vermiculite, etc

Sustainablility Considerations

- Non-toxic, naturally occurring, renewable, non-extractive ingredients
  - Limit or avoid peat moss, vermiculite, pearlite
- Live, biologically active mixes
  - Nutrients and innoculation support longer development before planting out
- Texture, structure, nutrient supply and cultural practices together foster growth

Some good choices

- Compost and garden soil (50/50)
- Compost, flat soil, garden soil (33/33/33)
- Organic potting soil:
  - composted bark, sphagnum peat moss, pasteurized poultry litter, organic wetting agent (N - 0.1%, P - 0.05%, K - 0.05%)
- *Coconut husk (coir) “mini-greenhouse”
- *Peat pellets “mini-greenhouse”
- *Test* - NoDampOff™ sphagnum peat moss

*Better to remove netting/peat pot for transplanting

Containers

- Cell/plug type trays
  - High density, limited media, individual units with limited root disturbance
  - Limited nutrients, root run, drainage, more frequent watering
- Traditional wooden flats
  - Full - 3 5/8” x 23 x 15 ; Half - 3 5/8” x 11 ½” x 15”
  - Deep 5 11/16” x 14” x 12 11/16”
  - Large root run, more moisture and nutrient supply
  - Heavier, less planting density

Cell / Plug containers for starting seedlings in a CSA Greenhouse

Home style Containers

- Gallon milk container bottoms
- Half gallon milk carton on side
- Commercial home alternatives:
  - Jiffy 72 position “greenhouse” w/ peat pellets
  - Burpee 25 position “coir” unit, recyclable
  - Gardener’s Supply Accelerated Propagation System combined with milled sphagnum moss media
- Rejects:
  - Last year’s plastic tray with organic (peat, vermiculite, lime, wetting agent) mix
  - Egg cartons, Apple “bubble” containers

Home Style Containers

“No Damp Off, The Ultimate in Seed Starting”
www.mosserlee.com for tips.

(Contents is sphagnum peat moss)

- 1. Mix equal parts of NoDampOff™ and hot tap water (about 4 cups product, a little less water) in a clean container. Save a little dry for later.
- 2. Stir the mixture until the water is absorbed. Lightly squeeze out excess water by hand and fill flats, trays, or pots.
- 3. Sow seeds on top of the moist NoDampOff™ and cover seeds with a sprinkling of dry NoDampOff™ to the depth recommended on seed packet for planting, usually 2 to 3 times the diameter of the seeds. Put in a sunny place.

Always wear protective gloves and wash hands after handling soil, plants and moss

Light

- Germination – not in direct sunlight, warm
- Light striking a green leaf causes photosynthesis – conversion through chlorophyll, of water and carbon dioxide to simple sugars and starches. The visible part of the spectrum provides the energy.
- Natural light – greenhouse, cold frame, south window
- Artificial – use fluorescent, not sunlamp or incandescent
  - One cool-white, one warm-white, or 2 daylight. Special plant growth tubes are not necessary, more expensive, last shorter
  - Longer tubes are better; light is weaker at the ends

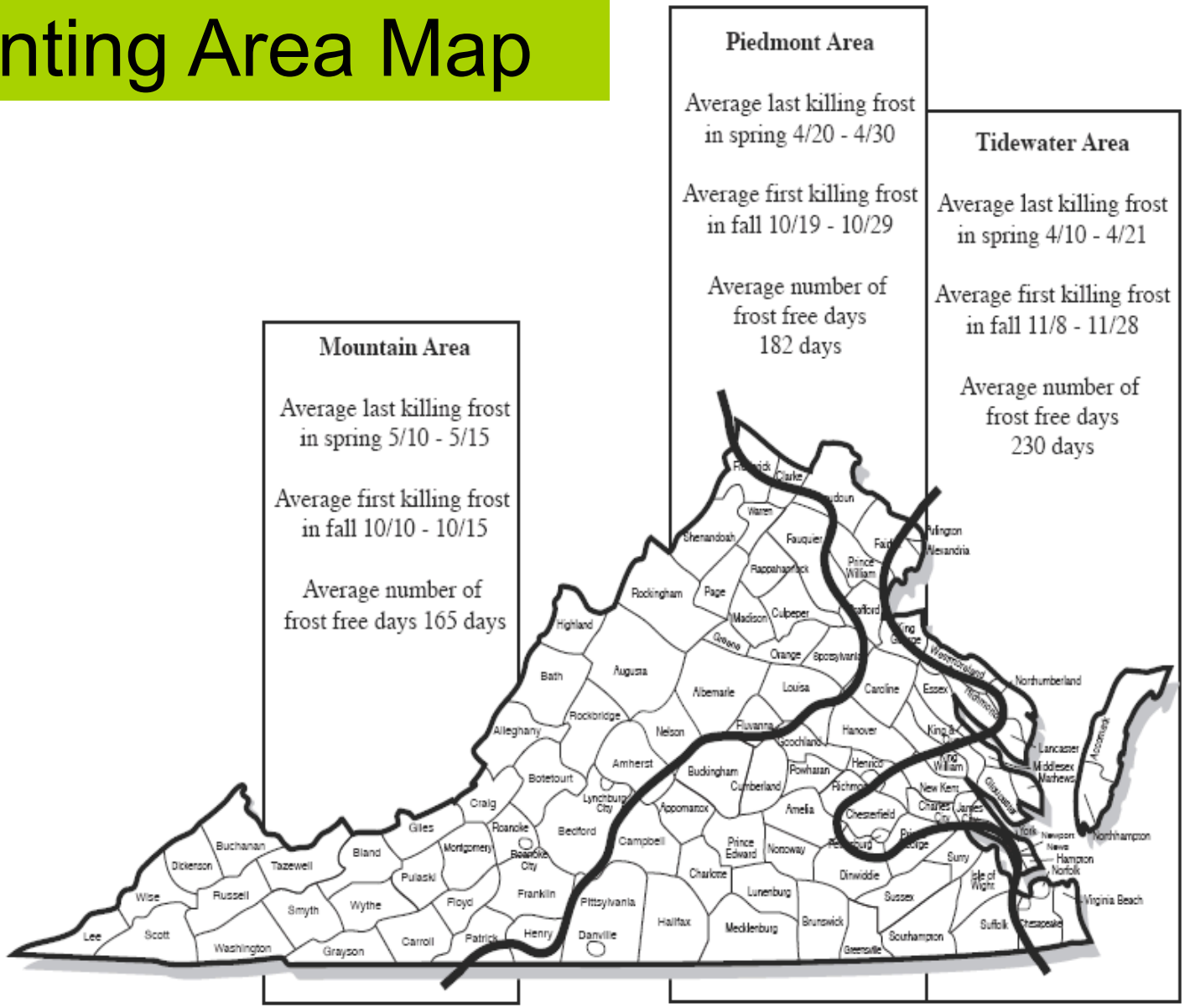
Providing light to seedlings after germination

- 16 hours on, 8 hours off daily. Plants digest and grow at night
- Distance from light: 3 to 4 inches
- Ideal temperatures: day – 70 to 75 F, night – 55 to 65 F

When to Start Seeds Indoors

- See individual instructions with seeds
- **Onion** seeds – 12-14 weeks before plant out, which is 4 to 6 weeks before last frost
- **Cabbage, Cauliflower, Brussels Sprouts, Broccoli**
  - Start in flats 4 to 6 weeks before planting out
- **Tomato, Eggplant, Pepper**
  - Start in flats 6 to 8 to 10 weeks before and transplant into deeper flats (6 in) or pots midway
- Many plants can be started in flats to save space in the garden and improve yield: **corn** (3-5 days), **wheat** (1-2 weeks), **melons** & cucumbers (2 to 4 wks), **herbs**, etc. Usually **not beans**.

Planting Area Map



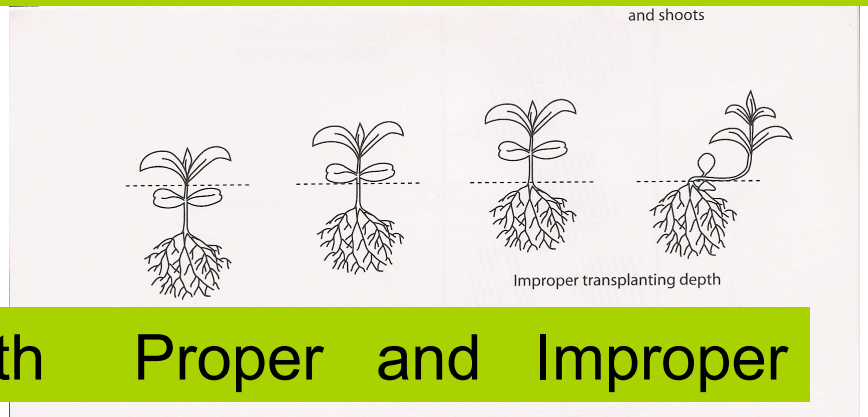
Planting Calendar (partial)

Month	March				April			May			June		
Date	1	11	21	31	10	20	30	10	20	30	9	19	29
Crop													
Turnips	P				H								
Potatoes		P									H		
Beets			P						H				
Cabbage*			P						H				
Carrots			P						H				
Lettuce, bibb			P							H			
Lettuce, leaf			P					H					
Broccoli*				P							H		
Brussels sprouts*				P								H	
Cauliflower*				P					H				
Beans, bush						P					P&H		
Beans, pole						P							
Corn, sweet						P							P&H
Cucumbers							P					P&H	
Eggplant*							P						

Problems

- Leaf curl, yellowing lower leaves: overfertilization
- Leggy plants: insufficient light, too much heat, crowding.
- Leaf discoloration: nutrient deficiency
- Mold: poor drainage, aeration, air movement
- Insect damage: conditions not ideal
- Damping off: fungus, stem withers at soil level. Cannot correct; can avoid through air circulation, proper watering, sterile medium, treating seedlings with garlic spray, chamomile or nettle tea
- Failure to sprout: 9 possibilities – temp, moisture, planted too deep, top watering float away, old or poorly stored seed, toxic soil, too little or much light

Looking Ahead -- Transplantation



Transplant Depth Proper and Improper

Before Transplanting Outdoors:

- Toughen indoors – less water, no fertilizer for the last week, cooler, block out plants growing in flats
- Acclimate plants to the outdoors – gradual exposure to sunlight, wind and cold for a period of 3 days to 2 weeks
- When transplanting, handle seedlings carefully by false leaves or stem. Dig the new hole first. Cradle root ball with a lifting tool

Planting Out - Seedlings

- As seeds become plants they are more valuable and more difficult to replace.
- Success depends on
  - Judgment: weather, temperature, moisture, microclimate, frost anticipation
  - Planting technique: hardened off, good day (cloudy, still, warm), large holes, compost, planting depths, handling, water as you go, fill with fine soil, press/firm gently, form a soil saucer
  - Shield from sun, wind, frost: shading, blocks, mulch, covers,

Direct Sowing Seeds

- Prepared beds
- Presoaking, Inoculating esp. legumes
- Mark soil: rows or centers
- Sowing depth: not more than 3x diameter, fine cover, firm seedbed, identify rows
- Weeding
- Thinning (if needed): consume or transplant

Plant Spacing - Snap Beans, bush
- Conventional vs Biointensive

- Plant “2" apart in rows 20" to 36" apart”
- RB =48(w) x 72(l)
- 2 rows, 36 per = 72 plants

- Plant on 6”centers, 621 max plants per 100 sq ft
- RB = 4x6 = 24 sq ft
- X= (24x621)/100 = approximately 144

Result: Twice as many plants, “further” apart, in same area, higher yield, uniform green umbrella microclimate
Why: deeply dug, richly composted soil provides more nutrients, better drainage, and more water.
Caution: Do not plant intensively in raised beds, unless they are double dug and richly composted. (most TG beds are not)

Questions?

Horticulture Help Line 703-792-7747

Resources & Credits

- Virginia Cooperative Extension On-Line Research References for Vegetable Gardening (Jan 24, 2011), attached to this package especially #14.
- Teaching Organic Farming and Gardening, Center for Agroecology & Sustainable Food Systems, UC Santa Cruz.
- The New Seed Starters Handbook, Nancy Bubel, Rodale Press, 1988.
- Teaming with Microbes, The Organic Gardener's Guide to the Soil Food Web, Jeff Lowenfels and Wayne Hughes, Timber Press, 2010.
- The Sustainable Vegetable Garden, John Jeavons and Carol Cox, Ten Speed Press, 1999.

VA Tech Farming - Kentland

- Plots are ¼ acre: 435x25, permanent paths and beds
- Compacted earth: smaller, less vigor, more pests
- Plants want for not: irrigation and organic fertilizer
- Champions: Alfalfa soil building; buckwheat and umbels
- All Dr Morse's work is for small farmers

Dr Ron Morse