



UNIVERSITY OF ILLINOIS
EXTENSION

Preparing a New Generation of Illinois Fruit and Vegetable Farmers

Transplant Success!

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¹Some slides developed by Chris Konieczka

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Why use transplants?

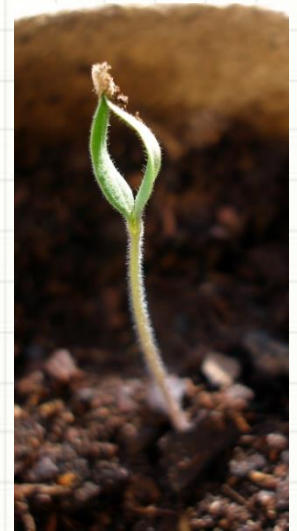
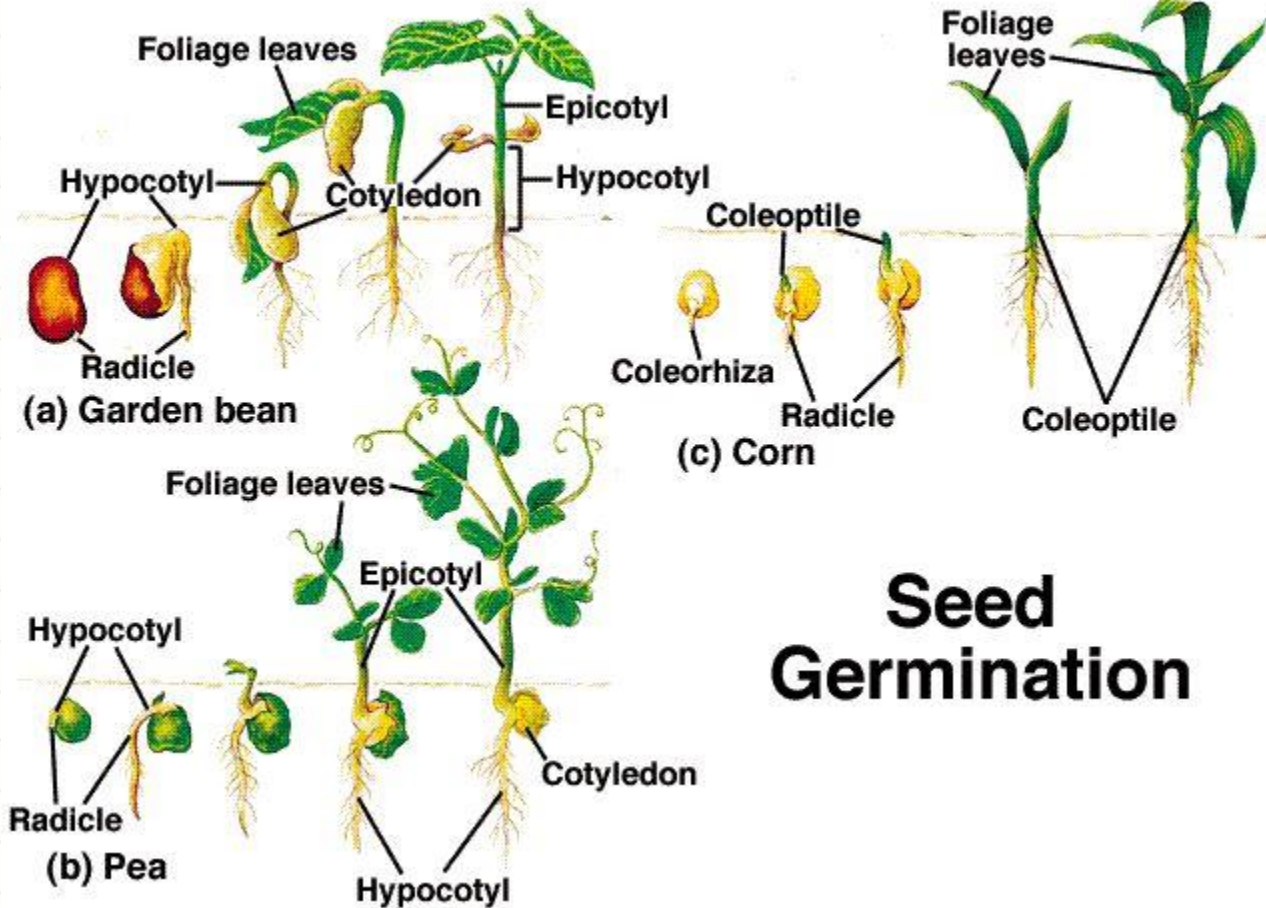
- Higher germination rate for expensive seeds
- Extends growing season – 4 to 6 week old plants are ready to set out soon as danger of frost has passed
- Earlier yields which allow for easier crop marketing

Hotbeds & Greenhouses



Seed Germination

Randy Moore, Dennis Clark, and Darrell Vodopich, Botany Visual Resource Library © 1998 The McGraw-Hill Companies, Inc. All rights reserved.

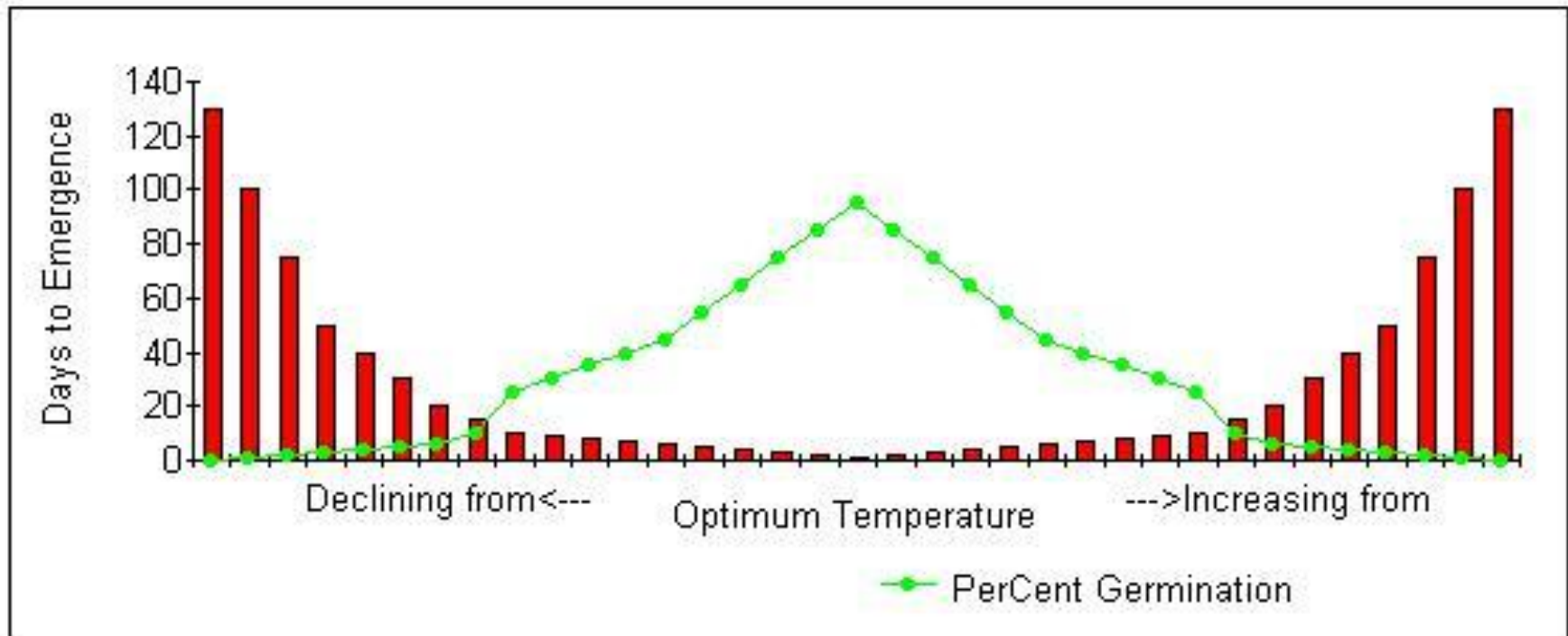


Seed Germination

Factors for seed germination

- 1. Viable seed: Seed must be alive (embryo)
- 2. Correct environmental conditions including:
 - a. Water
 - b. Temperature
 - c. Oxygen
 - d. Light
- 3. Lack of dormancy or dormancy released

Impact of Temperature



**Percentage of Normal Vegetable Seedlings
Produced at Different Temperatures* ****

Numbers in () are the days to seedling emergence. Number in red = optimal daytime soil temperature for maximum production in the shortest time.

Crops	32°F	41°F	50°F	59°F	68°F	77°F	86°F	95°F	104°F
Asparagus	0	0	61(53)	80(24)	88(15)	95(10)	79(12)	37(19)	0
Beans, lima	0	0	1	52(31)	82(18)	90(7)	88(7)	2	0
Beans, snap	0	0	1	97(16)	90(11)	97(8)	47(6)	39(6)	0
Beets	0	53(42)	72(17)	88(10)	90(6)	97(5)	89(5)	35(5)	0
Cabbage	0	27	78(15)	93(9)	0(6)	99(5)	0(4)	0	0
Carrots	0	48(51)	93(17)	95(10)	96(7)	96(6)	95(6)	74(9)	0
Cauliflower	0	0	58(20)	60(10)	0(6)	63(5)	45(5)	0	0
Celery	0	72(41)	70(16)	40(12)	97(7)	65	0	0	0
Cucumber	0	0	0	95(13)	99(6)	99(4)	99(3)	99(3)	49
Eggplant	0	0	0	0	21(13)	53(8)	60(5)	0	0
Lettuce	98(49)	98(15)	98(7)	99(4)	99(3)	99(2)	12(3)	0	0
Muskmelon	0	0	0	0	38(8)	94(4)	90(3)	0	0
Okra	0	0	0	74(27)	89(17)	92(13)	88(7)	85(6)	35(7)
Onions	90(136)	98(31)	98(13)	98(7)	99(5)	97(4)	91(4)	73(13)	2
Parsley	0	0	63(29)	0(17)	69(14)	64(13)	50(12)	0	0
Parstraps	82(172)	87(57)	79(27)	85(19)	89(14)	77(15)	51(32)	1	0
Peas	0	89(36)	94(14)	93(9)	93(8)	94(6)	86(6)	0	0
Peppers	0	0	1	70(25)	96(13)	98(8)	95(8)	70(9)	0
Radish	0	42(29)	76(11)	97(6)	95(4)	97(4)	95(3)	0	0
Spinach	83(63)	96(23)	91(12)	82(7)	52(6)	28(5)	32(6)	0	0
Sweet Corn	0	0	47(22)	97(12)	97(7)	98(4)	91(4)	88(3)	10
Tomatoes	0	0	82(43)	98(14)	98(8)	97(6)	83(6)	46(9)	0
Turnips	1	14	79(5)	98(3)	99(2)	100(1)	99(1)	99(1)	88(3)
Watermelon	0	0	0	17	94(12)	90(5)	92(4)	96(3)	0

Water and Oxygen



Dormancy

Types and Remedies

- Hard seed coat(many gourds)
 - Scarify seed coat
- Immature embryo
 - Allow for after ripening period
- Internal physiological dormancy
 - Stratification

Seeding Methods

- Broadcast
- Sown in rows
- Direct seeded into plug tray, jiffy pellet, grodan block etc.

Broadcast

- Broadcast onto surface randomly
- Used for fine seeds
- Damping off can be real problem



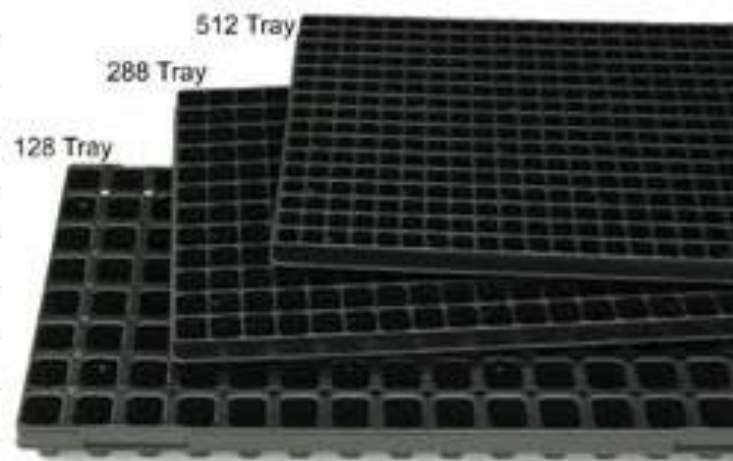
In Rows







Direct



Germinating









Potting

Container Selection

- Material
 - Plastic
 - Clay
 - Peat
- Size
 - Tomato: larger transplant=earlier fruit + higher yield
 - Must be large enough to support size of finished transplant

Consider Transplant Size when Looking for Extra-Early Hoop House Tomato Yields

Table 1

Influence of Transplant Size and Transplanting Date on Yield of Hoop House Grown "Road Runner" Tomato

Treatment			Early* Marketable Yield (lbs.)		Total Marketable Yield (lbs.)	
Container Size	Seeding Date	Transplanting Date	Per Treatment**	Per Plant	Per Treatment	Per Plant
6 - inch (1 quart)	21-Jan	13-Mar	29.4 A ***	9.8	66.5 A	22.2
6 - inch	6-Feb	13-Mar	29.9 A	10	62.2 AB	20.7
4.5 - inch (1 pint)	6-Feb	13-Mar	28.9 A	9.6	63.2 AB	21.1
4.5 - inch	21-Feb	27-Mar	19.4 B	6.5	55.7 BC	18.6
2 - inch (cell)	21-Feb	27-Mar	12.1 B	4	50.6 C	16.9

* = Accumulative Harvest through June 17th

** = Treatment is the average of three plants, replicated four times (12 plants per average).

*** = Values not connected by same letter are significantly different

Container Material

- Plastic
 - Economical
 - Light weight
 - May be reusable
 - Nearly infinite selection of sizes
 - Tends to stay wet



540mm x 280mm x 60mm



Clay

- Heavy
- Reusable
- Easier to keep dry



Peat

- Light weight
- Easy to keep dry
- Not reusable



Common soilless media

Plug Mix



Growing Media



Pro Mix BX

- Traditional peat-based growing medium with perlite and vermiculite
- Is pH-adjusted
- General-purpose growing mix for transplanting a wide variety of plant species
- Ideal for the production of vegetable transplants in large cell trays
- Contains MYCORRHIZAE™ mycorrhizal inoculum (Glomus intraradices)
- Contains BIOFUNGICIDE™ - (Bacillus pumilus – strain GHA-180)

- Canadian Sphagnum Peat Moss (75-85% by volume)
- Perlite - horticultural grade
- Vermiculite-horticultural grade
- Dolomitic and Calcitic limestone (pH adjuster)
- Wetting Agent
- Mycorrhizae – endomycorrhizal inoculum (*Glomus intraradices*)
- BIOFUNGICIDE™ - (Bacillus pumilus – strain GHA-180)









Transplant Growing

- Water only when needed
- Apply fertilizer
- Maintain good light
- Maintain proper temperatures
- Have good air circulation
- Maintain proper plant spacing

Fertilizer



GUARANTEED ANALYSIS
For Continuous Liquid Feed Programs

Total Nitrogen (N)	20%
3.94% ammoniacal nitrogen	
6.05% nitrate nitrogen	
10.01% urea nitrogen	
Available phosphate (P ₂ O ₅)	20%
Soluble potash (K ₂ O)	20%
Magnesium (Mg) (Total)	0.05%
0.05% water soluble magnesium (Mg)	
Boron (B)	0.0068%
Copper (Cu)	0.0036%
0.0036% chelated copper (Cu)	
Iron (Fe)	0.05%
0.05% chelated iron (Fe)	
Manganese (Mn)	0.025%
0.025% chelated manganese (Mn)	
Molybdenum (Mo)	0.0009%
Zinc (Zn)	0.0025%
0.0025% chelated zinc (Zn)	

Derived from: ammonium phosphate, potassium nitrate, urea, magnesium sulfate, boric acid, copper EDTA, iron EDTA, manganese EDTA, ammonium molybdate, zinc EDTA.

Potential Acidity: 565 lb. calcium carbonate equivalent per ton



<u>Crop</u>	<u>Day Temperature</u>	<u>Night Temperature</u>	<u>Weeks from seed</u>
Broccoli, Cabbage, Cauliflower	65	55-60	4-6
Celery	65	60	8-12
Eggplant	70-80	60	6-8
Lettuce	60-65	50	3-5
Melons	70-75	60	2-3
Onions	65-70	55-60	6-8
Peppers	70-75	60	6-8
Tomatoes	65-70	60	5-8









Keys to Success

- Good sanitation
- Good light quality and quantity
- Proper Temperature Regimes

Sanitation

- Clean seed (or other propagule)
- Sterilized Containers, Tools, Benches
- No Wand/Breaker on Ground
- Lids on Garbage Cans
- No Weeds in Greenhouse
- Wash Hands especially if Tobacco user
- Soilless media

Soil Blocking

Why use soil blocks?

- ☐ Better root environment – more air circulation, less pruning/binding in cells
- ☐ Improved water holding capacity
- ☐ Reduce incidence of transplant shock
- ☐ Usually can remain in flats longer than plug cells
- ☐ Less waste (fewer plastic trays)

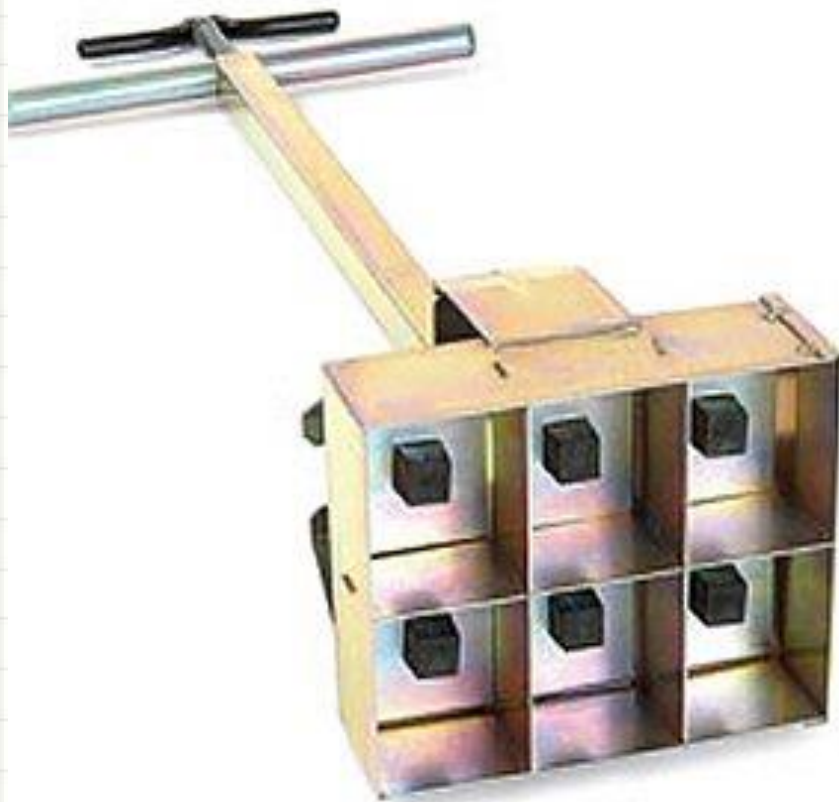
Soil Blocking



Soil Blocking



Soil Blocking



Soil Block Mix

- 3 buckets brown peat
- ½ cup lime
- 2 buckets perlite
- 3 cups fertilizer mix
- 1 bucket soil
 - 10 quart bucket
 - Makes 2 bushels
- Existing soilless mix can be amended with fertilizer, soil, and compost
- Mix not sterilized, can sterilize soil before mixing if needed



Other Organic Transplant Mixes

- MSU-SOF Compost based mix

- 1 bale straw
- 1 bale hay or alfalfa mix
- 1 bale wood shavings
- 1 bale peat moss
- 6 cubic ft (wheel barrow) each soil and grass clippings
- 6 cubic ft green plants

- Material is mixed in a small manure spreader with water
- Brought to 140F and mixed again with alfalfa meal to help reheat
- Allowed to mature over summer
- Perlite added along with slowly available organic fertilizer or fertilized with water soluble fertilizer



Seed Storage

- ☐ The sum of temperature in ° F and relative humidity (RH) should be near 80
- ☐ -40° -45° F
- ☐ -35%-40% RH
- ☐ Viability declines with time



Disease/Pest Management

Pests and Treatments

- ☐ Aphids
- ☐ Thrips
- ☐ Slugs
- ☐ Virus resistant seed





Thrip



Disease/Pest Management

- ❑ Group of soil borne pathogens including-
- ❑ *Rhizoctonia*, *Phytophthora*, *Botrytis*, *Fusarium*, *Pythium*, *Sclerotinia* spp.
- ❑ Affects seeds and germinating seedlings
- ❑ Signs – white mold at soil surface
- ❑ Symptoms – dark stem spots, rotten roots and stems, ‘wiry stem’

Damping Off



Disease/Pest Management

Damping Off



Look for patterns among your flats to detect damping off.

Disease/Pest Management

Damping Off

Prevention

- ☐ Sanitation
- ☐ Soilless media
- ☐ Air circulation
- ☐ Timely planting
- ☐ Even watering

☐ Treatment

- ☐ Fungicide (as spray or drench)
- ☐ Quarantine and dispose

Field Planting



- ☐ Avoid Transplant Shock
- ☐ Harden off plants
- ☐ Handle with care
- ☐ Pay attention to roots
- ☐ Planting depth
- ☐ Water

Field Planting

Considerations

- ☐ Select healthiest transplants
- ☐ Timing of planting
- ☐ Rain/Irrigation
- ☐ Root/soil contact
- ☐ Transplant Shock



Field Planting



Adjustments to your system may be necessary if switching from hand transplanting to mechanical transplanting.

Field Planting

- ☐ Mechanical Transplanting
- ☐ Water with transplant
- ☐ Faster for large plantings
- ☐ Bed must be passable with equipment
- ☐ Requires minimum of 2 people



Field Planting

Hand Planting

- ☐ Smaller acreages
- ☐ Wet conditions OK
- ☐ Rows can be uneven
- ☐ Irrigate after



Field Planting



Field Planting Considerations

- ☐ Straight rows
- ☐ Spacing
- ☐ Planting depth
- ☐ Nutrition
- ☐ Row covers
- ☐ Adapt to system



Planning

Crop Selection

- ☐ Sufficient variety of crops
- ☐ Early and late maturing cultivars
- ☐ Crops that are successful in your area



Check out this link for varietal ratings -

<http://vegvariety.cce.cornell.edu/index.php>

Crop Planning

- ☐ Frost free period (~April 15-Oct. 15)
- ☐ Days til plantout?
- ☐ How much to plant?
- ☐ How many plantouts?
- ☐ Keep good records for future planning



<http://clydesvegetableplantingchart.com/Vegetable-Garden-Planner.aspx>

Planning - Determine harvest outcomes for each crop

- ☐ How much per harvest? (lbs., heads, bunches)
- ☐ Frequency of harvests?
- ☐ Over what time period?
- ☐ Add 25% cull rate



- ☐ Example: per 100 CSA shares (24 total weeks June 4 – November 12)
- ☐ Need 1 head x 100 shares per week = 100 harvestable heads per week
- ☐ Add 25% cull rate for poor quality transplants, crop loss, etc. $100 \times 1.25 = 125$ plants per week
- ☐ Want to provide a head of lettuce in 16 of 24 weeks of CSA. $125 \times 16 = 2,000$ total lettuce plants needed

Planning

- ☐ You can create your own plan using excel, access, or other database software
- ☐ Not only for transplants, but for all field production
- ☐ Better records mean better planning

Resources

- <http://extension.umass.edu/floriculture/factsheets/damping-bedding-plants-and-vegetables>
- <https://www.morgancountyseeds.com/store/>
- <http://www.veggiecompass.com/>
- <http://clydesvegetableplantingchart.com/Vegetable-Garden-Planner.aspx>
- http://bse.wisc.edu/HFHP/tipsheets_pdf/dibble4web.pdf
- <http://www.nevegetable.org/index.php/management>

Resources

- <http://www.gpnmag.com/height-control-vegetable-transplants-0>
- <http://www.uky.edu/Ag/Horticulture/anderson/orgfert1.pdf>
- <http://www.uky.edu/Ag/Horticulture/anderson/orgfert3.pdf>
- <http://www.hoophouse.msu.edu/assets/custom/files/Develop%20A%20Transplant%20Action%20Plan.pdf>

Resources

- <http://www.msuorganicfarm.com/Transplants.pdf>
- <http://extension.psu.edu/start-farming/courses/files/select-seeding>
- <https://attra.ncat.org/attra-pub/summaries/summary.php?pub=55>
- <http://www.agsquared.com>

Happy Transplanting!

Questions?

Visit our websites to find out about other programs and events:

Illinois SARE – www.illinoissare.org

Illinois Small Farms -

<http://web.extension.illinois.edu/smallfarm/>



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