Seeds, Seeding & Growing Transplants

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The Kerr Center
for Sustainable Agriculture

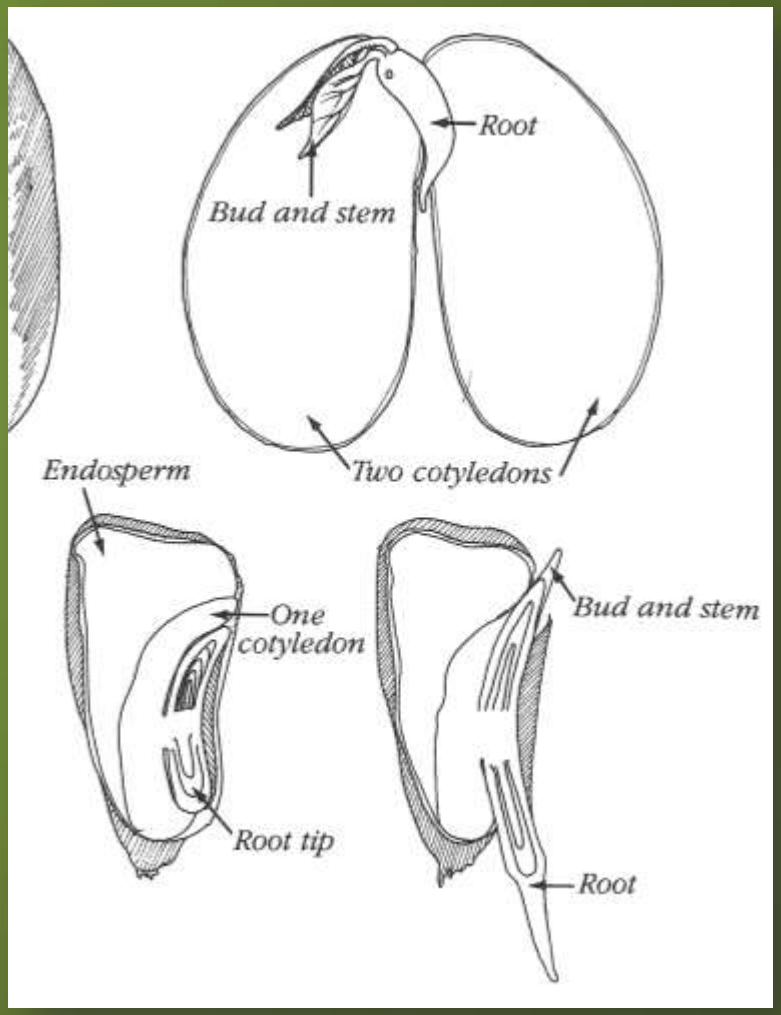
United States Department of Agriculture

National Institute of Food and Agriculture

Understanding Seeds:
How seeds work

Botany of the Seed:

A. Self-contained package
   1. Genetic material
   2. Embryonic plant
   3. Stored food

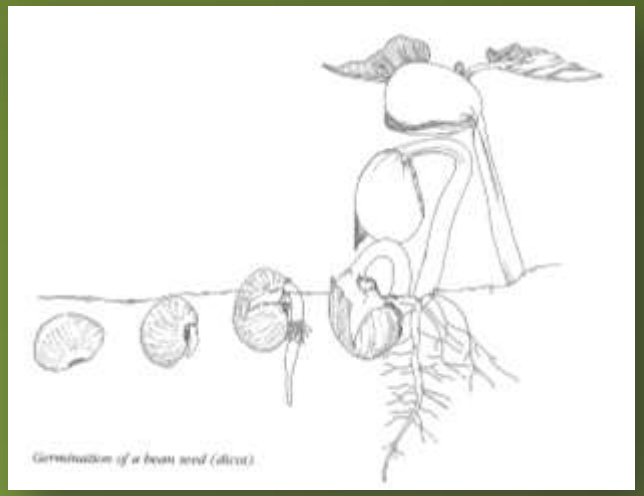


Understanding Seeds:
How seeds work

Dormancy:

A. Waiting until the time is right
B. Breaking seed dormancy
    1. Temperature, chilling
    2. Light, exposure
    3. Physical abrasion, scraping seed
C. Dormancy is not an issue with most vegetable seed

Understanding Seeds:
How seeds work



Germination

A. Moisture
B. Temperature
    1. Optimum usually between 75˚F and 90˚F
    2. Depends on the seed type
C. Air
D. Light
    1. Some seeds need light, some need darkness

The Johnny's Catalog

Optimum germination temperature

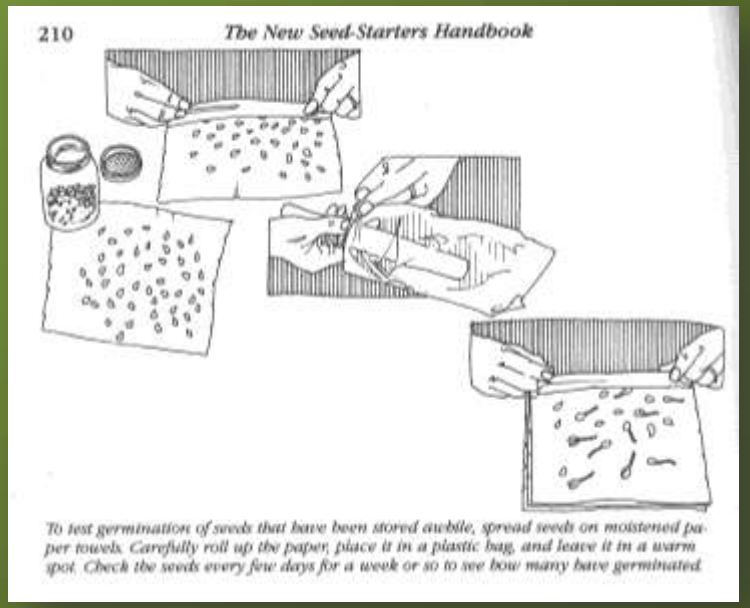
Understanding Seeds:
How seeds work

Germination Tests:

A. Testing for seed viability
    1. Moist paper towel, rolled and placed in a sealed plastic bag
    2. Potting media

B. Keep warm, 70˚F to 80˚F

C. Calculate percentage of that germinated



Understanding Seeds:
Storing seeds

The Right Storage Environment

A. Cool temperature, 32˚F to 41˚F
B. Low moisture, 4-6%
    1. Make sure that seeds and seed packets are completely dry before storage
C. Use containers with tightly-sealing lids
D. Most seeds will keep about 3 years

Understanding Seeds:
Storing seeds

Seed viability chart taken from

The New Seed-Starters Handbook

Seed Viability

Approximate age at which seed of good initial viability stored under cool, dry conditions still gives a satisfactory stand of vigorous seedlings with a normal rate of seeding.

Seeds	*Years*	*Seeds*	*Years*
Asparagus	3	Leeks	3
Beans	3	Lettuce	5
Beets	4	Martynia	2
Broccoli	5	Muskmelons	5
Brussels Sprouts	5	Mustard	4
Cabbage	5	Okra	2
Cabbage, Chinese	5	Onions	1
Cardoon	5	Parsley	1
Carrots	3	Parsnips	1
Cauliflower	5	Peas	3
Celeriac	5	Peas, Southern (See Cowpeas)	...
Celery	5	Peppers	2
Chervil	3	Pumpkins	4
Chicory	5	Radishes	5
Ciboule	2	Roselle	3
Collards	5	Rutabagas	4
Corn	2	Salsify	1
Corn-salad	5	Salsify, Black	2
Cowpeas (Southern Peas)	3	Sorrel	3
Cress, Garden	5	Spinach	5
Cucumbers	5	Spinach, New Zealand	5
Dandelions	2	Squash	4
Eggplant	5	Swiss Chard	4
Endive	5	Tomatoes	4
Fennel	4	Turnips	4
Kale	5	Watercress	5
Kale, Sea	1	Watermelons	4
Kohlrabi	5		

Source: Oscar A. Lorenz and Donald N. Maynard, *Knott's Handbook for Vegetable Growers*, 2d ed. (New York: John Wiley and Sons, 1980).

Understanding Seeds:
Choosing the right seeds

Variety Selection:

A. *Heirloom or Open Pollinated (OP)*
   1. Necessary if planning on saving seed

B. *Hybrid (F1)*
   1. Traditional breeding
   2. Cross between two different parents

C. *Genetically Engineered (GE or GMO)*
   1. Genes from another species inserted into DNA
   2. ***Not allowed in organic production***

Understanding Seeds:
Choosing the right seeds

Other Considerations:

A. Adaption to regional climate
B. Disease and pest resistance
C. Days to maturity
D. Flavor and keeping quality
E. Customer preference

High Mowing Seed Catalog

Disease resistance

Cabbage *Brassica oleracea*

2348 Copenhagen

PLANTING INFO: Days to maturity are from spring transplanting; if transplanting in warm weather subtract 10-14 days; direct seeding add 14 days. *Seeding depth:*

GREEN

2358 Primax *60 days*
Early fresh market cabbage with tender leaves and excellent flavor. Small to medium size heads are round averaging 2-4 lbs per head. Primax has a light-green interior with a short core and darker green wrapper leaves. Holds well in the field.

2366 Farao F1 Hybrid *63 days*
TB, T
Sweet and tender! Leaves are thin and juicy - perfect for stir-fries and egg rolls. Medium green leaves with a rosebud wrapper will make any garden or farmers' market table look stunning. Round heads average 3-4 lbs and hold well in the summer heat. Suitable for dense plantings.

NEW **2348 Copenhagen** *65 days*
HEIRLOOM - A great open-pollinated variety for home gardeners and direct markets. Round solid heads are somewhat variable in size ranging from 3-4 lbs and 6-8" in diameter with uniform maturity. Compact plants have short stems and sit close to the ground. Heads hold well in the field without splitting. Great for slow cooking, slaws and sauerkraut.

2349 Caraflex F1 Hybrid *68 days*
Green sweetheart cabbage for fresh market. Caraflex is well known for its thin, sweet leaves that are delicious eaten raw or in stir fries, slaws or egg rolls. Small heads average 1.5-2 lbs. Plants are extremely uniform and have good wrapper leaves for insect and sun protection.

2357 Capture F1 Hybrid *85 days*
FY, BR, T

2366 Farao F1

2358 Primax

2349 Caraflex F1

2357 Capture F1

2356 Drago F1

2347 Kaitlin F1

...ers at base of stem or brown circular leaf spot... ...ial Soft Rot or Head Rot is caused by a few diffe... ...terial species (mainly *Erwinia spp* and *Pseaud... ...spp*) and can develop quickly under conditio... ...gh moisture and high temperature. Black Rot (... ...*monas campestris Xcc*) results in chlorosis of leav... ...ning with older to newer, and can lead to dea... ...ts. Disease first appears as V-shaped, yellow... ...t the leaf margin. Disease can be prevented b... ...g with copper, sulfer and/or oxidate but is best... ...by crop rotations, adequate spacing and orie... ...ot working with plants when wet, and destro... ...cted plant debris. Insect pests, including cabb... ...per (*Tricholousia ni*), imported cabbage ...*rae*), and diamondback moth (*Plutella xy...* ...be controlled by applying beneficial fungi... ...as *Bacillus thuringiensis* (Dipel DF™) and/or spino... ...ad (Entrust™), preferably in rotation with one another to prevent selection of resistant individuals.

RESISTANCE KEY: BS-Black Speck, BR-Black Rot, CR-Club Root (races indicated), FY-Fusarium Yellows and Wilt, T-Thrips, TB-Tip Burn, TMV-Turnip Mosaic Virus.

SEED SPECS: 4,875-9,750 seeds/oz (7,300 avg); 78M-156M seeds/lb (117M avg). ***Seeding rate:*** 48M seeds/acre (6.5 oz/acre) using 2 seeds/ft, 24" row spacing. M=1,000

The white coloring indicates high levels of Vitamin C. Holds very well in the field and matures uniformly for late season processing. Mid term storage.

2359 Impala F1 Hybrid *105 days*

BS, TMV

High quality, ball-head variety with exceptional holding capacity in field and storage. Dense heads with open green wrapper leaves and a snow white interior, indicating a high Vitamin C content. Plants sit high on stem for easy harvests as well as protection from pests and disease. Heads average 6-8 lbs under normal conditions but Impala has a potential for larger heads up to 10 lbs. Stores up to 4-6 months under proper conditions. Excellent disease resistance as well as tolerance to Tip Burn and thrips.

RED

2369 Red Express *62 days*

We were pleasantly surprised by this open-pollinated variety in our trials. It heads up quickly into neat and tidy little red cabbages, perfect for those who want a smaller portion. Uniform with very nice color, and much, much earlier than many other cabbage varieties. Try a tightly planted block at 8" spacing with Farao and Famosa for a knock out display and earlier harvest!

When to Plant:
Determining planting dates

Field Planting

A. Cooperative Extension publications
    1. *OSU Garden Guide on flash drive*
B. Calculate dates based on first average frost
    1. National Weather Service website
C. Monitor soil temperature
D. Anticipate weather patterns

OKLAHOMA COOPERATIVE EXTENSION SERVICE HLA-6004

Oklahoma Garden Planning Guide

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Well-planned, properly managed home
furnish Oklahoma families with flavorful, high
vegetables from spring through fall, as well as f
or storing for winter.

The amount of money invested in seeds, f
ticides, and a few tools is more than offset by th
healthful outdoor exercise, and fresh "homegro

Choosing the Site

The selection and preparation of the garc
important key to growing a home garden success
exposed to full or near full sunlight with deep,
fertile soil is ideal. The site should also be locate
supply and, if possible, away from trees and shru
compete with the garden for light, water, and n

While these conditions are ideal, many urb
have a small area with a less than optimal site
grow vegetables. Yet, it is still possible to grow
garden by modifying certain cultural practices
crops grown. Areas with light or thin shade
such as those under young trees, under matu
high lacy canopies, or in bright, airy places whic
one to two hours of direct sun per day. Ther
vegetables which will grow under these conditi
beans, beets, broccoli, cabbage, cauliflower, ch
leaf lettuce, peas, potatoes, radishes, rhubarb,
turnips. Unfortunately, few vegetables will gro
full, dense shade. If the site is not well drainec
is thin, the use of raised beds can help with thi

Planning the Garden

The accompanying chart should be of help i
family requirements of the different vegetables

Perennial vegetables (asparagus, rhubarb,
etc.) should be planted at one side or end of t
efficient operation. The hardy vegetables plante
season should be planted together, so they ma
with late season plantings of the same or othe
Vegetables requiring similar cultural practice
grouped together for ease of care.

The chart groups vegetables as cool sea

Garden Planning Guide

Vegetable	Time to Plant	Feet of Row Per Person	Days to Harvest	Method of Planting	Spacing Between Rows	Spacing Within Rows	Depth to Cover Seed	Quantity Needed Per Person	Frost Tolerance
Cool Season									
Asparagus	Fall or Spring	10-20	—	Crowns	4 ft.	2 ft.	6 in.	3-5	Hardy
Beet	March	10-20	50-70	Seed	1 1/2 ft.	4 in.	1 in.	1/8 oz.	Semi-Hardy
Broccoli	March	10	80-90	Plants	3 ft.	1 1/2 ft.		6-7 plants	Hardy
Cabbage	Feb. 15 to March 10	10-20	60-90	Plants	3 ft.	1-1 1/2 ft.		6-15 plants	Hardy
Carrot	Feb. 15 to March 10	20	70-90	Seed	1 1/2 ft.	3 in.	1/2 in.	1/8 oz.	Semi-Hardy
Cauliflower	Feb. 15 to March 10	15	70-90	Plants	3 ft.	1 1/2 ft.		6-8 plants	Semi-Hardy
Chard, Swiss	Feb. 15 to March 10	10	40-60	Seed	1 1/2 ft	3 in.	1/2 in.	1/2 oz.	Semi-Tender
Kohlrabi	Feb. 15 to March 10	10	50-70	Seed	2 ft.	6 in.	1/2 in.	1/8 oz.	Hardy
Lettuce, Head	Feb. 15 to March 10	20	60-90	Seed or Plant	1-1 1/2 ft.	1 ft.	1/4 in.	1/8 oz. or 20 plants	Semi Hardy
Lettuce, Leaf	Feb. 15 to March 10	20	40-70	Seed or Plant	1-1/ 2 ft.	3 in.	1/4 in.	1/8 oz or 40 plants	Semi-Hardy
Onion	Feb. 15 to March 10	25	60-120	Sets	1-1 1/2 ft.	4 in.	1 in.	1/4 qt. sets	Hardy
Onion	Feb. 15 to March 10	25	60-120	Plants	1-1 1/2 ft.	4 in.	1 in	1/8 oz. or 75 plants	Hardy
Peas, Green	Feb. 15 to March 10	30	60-90	Seed	3 ft.	2 in.	2 in.	1/4 lb.	Hardy
Potato, Irish	Feb. 15 to March 10	50	90-120	Tuber pieces 2-3 oz.	3 ft.	1 ft.	4 in.	6-8 lbs.	Semi-Hardy
Radish	March 1 to April 15	15	25-40	Seed	1 ft.	2 in.	1/2 in.	1/8 oz.	Hardy
Rhubarb	Fall or Spring	12	—	Crowns	4 ft.	2 ft.	3 in.	3-4 crowns	Hardy
Spinach	Feb. 15 to March 10	35	50-70	Seed	1 1/2 ft.	2 in.	1/2 in.	1/4 oz.	Hardy
Turnip	Feb. 15 to March 10	20	50-60	Seed	1 1/2 ft.	3 in.	1/2 in.	1/8 oz.	Hardy

These dates indicate planting times from southeast to northwest Oklahoma. Specific climate and weather may influence planting dates. For cool season vegetables, the soil temperature at the depth where the seeds are planted should be at least 40°F.

Seed Starting Guide - Arkansas River Valley

Crop	Spring/Summer Planting							Fall Planting							Germination		
	Direct Seed or Transplant	Days from Indoor to Field Planting	Indoor Dates		Planting Relative to First Frost-Free Date	Field Dates		Direct Seed or Transplant	Days from Indoor to Field Planting	Indoor Dates		Planting Relative to Last Frost Date	Field Dates		Range (°F)	Optimum Temp (°F)	Days
			First	Last	3/26	First	Last			First	Last	11/5	First	Last			
Artichoke	**TP**	56	1/30		on date	3/26	-						-	-	60-80	75	
Arugula	**DS**	-	-	-		2/15	3/10								45-80	65	
Asparagus	**Crowns**/TP	84-98	12/17	12/31	on date	3/26		**Crowns**/TP	-						50-95	75	
Bean, bush	**DS**	-	-	-	on date	3/26	5/1	**DS**	-	8/10	8/20		-	-	60-95	80	6
Bean, pole	**DS**	-	-	-	on date	3/26	5/1	**DS**	-	7/15	7/30		-	-	60-95	80	8
Beet	TP/**DS**	28-42	1/30	2/13	14 before	3/12	4/1	**DS**	-				8/5	8/24	40-95	85	5
Broccoli	**TP**	28-42	1/30	2/13	14 before	3/12	3/31	**TP**	28-42				7/15	8/13	55-85	75	
Brussles Sprouts	-	-	-	-	-	-	-	**TP**	28-42	5/27	7/4		7/8	8/15	45-95	80	5
Cabbage, Chinese	**TP**	28-42	1/16	2/27	28 before	2/27	3/26	**TP**	28-42				8/1	8/30	55-100	88	
Cabbage, fresh eating	**TP**	28-42	1/16	2/27	28 before	2/27	3/26	**TP**	28-42				7/13	8/25	40-100	85	
Cabbage, storage	**TP**	28-42	1/16	2/27	28 before	2/27	3/26	**TP**	28-42				8/7	8/25	40-100	85	
Carrot	**DS**	-	-	-		2/15	3/10	**DS**	-	-	-		7/23	8/11	45-85	80	6
Cauliflower	**TP**	28-42	1/30	2/27	14 before	3/12	3/26	**TP**	28-42				7/26	8/14	40-100	80	
Celeriac	**TP**	70-84	1/9	1/23	7 after	4/2		**TP**	70-84				6/30		40-100	75	
Celery	**TP**	70-84	1/9	1/23	7 after	4/2		**TP**	70-84				6/20		40-85	70	
Chicory, Endive/Escarole	**TP**	14-21	1/23	2/6	21-28 before	2/27	3/5	**TP**	14-21				8/18	9/6	40-85	75	
Chicory, Radicchio	**TP**	14-21	1/23	2/6	21-28 before	2/27	3/5	**TP**	14-21				7/29	8/17	40-85	75	
Collard Greens	**TP**/DS	28-42	1/16	1/30	28 before	2/27	3/10	**TP/DS**	28-42				8/9	9/1	55-95	85	5
Corn, sweet	**DS**	-	-	-		3/25	4/30	**DS**	-	7/15					50-105	95	
Cucumber	TP/**DS**	21-28	3/5	3/19	1-14 after	4/2	4/9	TP/**DS**	21-28	7/12	7/20		8/10	8/20	60-105	95	3
Eggplant	**TP**	56-70	1/30	2/20	14-21 after	4/9	4/16	**TP**	56-70	5/6	5/20		7/15		60-95	85	
Fennel	TP/**DS**					2/15	3/10	**DS**	-				7/1	7/20	50-95	77	
Garlic	-	-	-	-	-	-	-	**Bulbs**	-	-	-		9/1	10/15	-	-	
Greens, Asian	**DS**					2/15	3/10	**DS**	-				8/10	8/29	45-85	77	
Greens, salad mix	**DS**					2/15	3/10	**DS**	-				8/10	8/29	50-85	77	
Kale	**TP**	28-42	1/16	1/30	28 before	2/27	3/10	**TP/DS**	28-42				8/9	9/1	55-95	85	
Kohlrabi	**TP**	28-42	1/16	1/30	28 before	2/27	3/10	**TP/DS**	28-42				8/18	9/6	45-85	77	
Leeks	**TP**	54-70	1/2	1/16	14 before	3/12		**TP**	54-70				7/13	9/1	45-90	77	
Lettuce, baby	**DS**	-	-	-	-	2/27	3/5	**DS**	-				8/1	9/8	35-85	75	2
Lettuce, head	**TP**	28-35	1/23	2/6	21-28 before	2/27	3/5	**DS**	-				8/1	8/29	35-85	75	2
Lettuce, leaf	**TP**	28-35	1/23	2/6	21-28 before	2/27	3/5	**DS**	-				8/1	8/29	35-85	75	2
Muskmelon	**TP**/DS	21-28	3/12	3/19	14 after	4/9	6/1						-	-	60-100	90	3
Mustard, baby	**DS**	-	-	-	28 before	2/27	3/10						9/10	10/10	50-85	77	
Mustard, bunching	TP/**DS**	28-42	1/16	1/30	28 before	2/27	3/10						9/10	10/10	50-85	77	
Okra	TP/**DS**	28-42	2/27	3/26	14-28 after	4/9	4/23						-	-	60-105	95	6
Onion	**TP**	56-70	12/19	1/2	28 before	2/27		**TP/DS**	56-70				8/17	9/1	35-95	75	
Parsnip	**DS**	-	-	-				**DS**	-				6/23	8/15	35-85	65	
Pea, snap	TP/**DS**	21-28	1/2	1/23	42-56 before	1/30	2/13	**DS**	-				7/26	9/1	40-85	75	6
Pepper, hot	**TP**	56	2/13	3/5	14 after	4/9	5/1	**TP**	56	5/20			7/15		60-95	85	
Pepper, sweet bell	**TP**	56	2/13	3/5	14 after	4/9	5/1	**TP**	56	5/20			7/15		60-95	85	8
Potato	**DS**	-	-	-		2/15	3/10						8/1	8/15	-	-	-
Pumpkin	TP/**DS**	21-28	3/12	3/19	14 after	4/9	6/10	TP/**DS**	21-28	6/17	7/9		7/15	7/30	60-100	90	
Radish	**DS**	-	-	-		3/1	4/15	**DS**	-				8/15	9/30	40-95	85	3
Radish, Daikon	**DS**	-	-	-		3/1	4/15	**DS**	-				8/15	9/30	50-95	85	
Rutabaga	-	-	-	-	-	-	-	**DS**	-				8/7	9/15	45-85	77	
Spinach	**TP**/DS	28-42	1/2	2/6	21-42 before	2/13	3/5	**DS**	-				9/5	9/12	35-85	70	5
Squash, summer	TP/**DS**	21-28	3/12	3/19	14 after	4/9	5/1	TP/**DS**	21-28	6/17	8/10		7/15	9/1	60-100	95	3
Squash, winter	TP/**DS**					5/15	6/15	TP/**DS**					7/15	7/30			
Swiss Chard	TP/**DS**	28-42	1/30	2/13	14 before	3/12		**DS**	-				8/1	9/2	50-85	85	
Tomatillo	**TP**	28-35	3/12	4/10	14-28 after	4/16	5/15	**TP**	28-35				7/1	7/15			

When to Plant:

Determining planting dates

Planting in the Greenhouse

A. Count backwards from field planting date

B. Know how long from seeding to transplanting

   1. Usually 4 to 6 weeks

Seed Starting Guide - Arkansas River Valley

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			First	Last	3/26	First	Last			First	Last	11/5	First	Last			
Artichoke	TP	56	1/30		on date	3/26	-						-	-	60-80	75	
Arugula	DS	-	-	-		2/15	3/10								45-80	65	
Asparagus	Crowns/TP	84-98	12/17	12/31	on date	3/26		Crowns/TP	-						50-95	75	
Bean, bush	DS	-	-	-	on date	3/26	5/1	DS	-	8/10	8/20		-	-	60-95	80	6
Bean, pole	DS	-	-	-	on date	3/26	5/1	DS	-	7/15	7/30		-	-	60-95	80	8
Beet	TP/DS	28-42	1/30	2/13	14 before	3/12	4/1	DS	-				8/5	8/24	40-95	85	5
Broccoli	TP	28-42	1/30	2/13	14 before	3/12	3/31	TP	28-42				7/15	8/13	55-85	75	
Brussles Sprouts	-	-	-	-	-	-	-	TP	28-42	5/27	7/4		7/8	8/15	45-95	80	5
Cabbage, Chinese	TP	28-42	1/16	2/27	28 before	2/27	3/26	TP	28-42				8/1	8/30	55-100	88	
Cabbage, fresh eating	TP	28-42	1/16	2/27	28 before	2/27	3/26	TP	28-42				7/13	8/25	40-100	85	
Cabbage, storage	TP	28-42	1/16	2/27	28 before	2/27	3/26	TP	28-42				8/7	8/25	40-100	85	
Carrot	DS	-	-	-		2/15	3/10	DS	-	-	-		7/23	8/11	45-85	80	6
Cauliflower	TP	28-42	1/30	2/27	14 before	3/12	3/26	TP	28-42				7/26	8/14	40-100	80	

How to Plant:

In the field

A. Seeding Depth
   1. Depends on size of seed
   2. Easily set by seeder
   3. Adjust depth of incorporation

B. Seed Spacing
   1. Seed thick and thin later

C. Distance Between Rows
   1. Think about wheel width of equipment

NEW **2348 Copenhagen**

PLANTING INFO: Days to maturity are from spring transplanting; if transplanting in warm weather subtract 10-14 days; direct seeding add 14 days. ***Seeding depth:*** ½", ***Direct seeding:*** 2-4 seeds/ft at desired plant spacing, thin to 1 plant/spacing, **Fresh market** - ***Plant spacing:*** 10-18", ***Row spacing:*** 12-18". **Storage/processing** - ***Plant spacing:*** 18-24", ***Row spacing:*** 18-34". Closer spacing and reduced fertility results in reduced head size. **CULTURAL INFO:** Cabbage is a hardy biennial, producing seed in its second year, and is closely related to broccoli and kale. Direct sow when daytime soil temps warm to 75°F or start seeds indoors or in cold frames 4-6 weeks before planting date. Optimal soil temperature for germination is 75°F but seeds will germinate in soils as cool as 50°F. Cabbage is mature when the tight outer leaf of the head begins to fold back on itself. Cut heads flat on underside. Cabbage is best stored at 32°F and 95% humidity. Fresh market varieties store for 2-3 weeks, while storage and processing types store for 2-6 months. **DISEASE & PESTS:** Fusarium Yellows (*Fusarium oxysporum f. sp. Conglutinans*) results in yellowing of the lower and then upper leaves, eventually causing wilt. Downy Mildew (*Peronospora parasitica*) is a wide spread systemic fungal disease that can cause the stem to pith and head to turn black and rot. Black Leg (*Phoma lignam*), also known as stem canker, appears as black sunken cankers at base of stem or brown circular leaf spots. Bacterial Soft Rot or Head Rot is caused by a few different bacterial species (mainly *Erwinia spp* and *Pseaudomonas spp*) and can develop quickly under conditions of high moisture and high temperature. Black Rot (*Xanthomonas campestris Xcc*) results in chlorosis of leaves, beginning with older to newer, and can lead to death of plants. Disease first appears as V-shaped, yellow lesions at the leaf margin. Disease can be prevented by spraying with copper, sulfer and/or oxidate but is best avoided by crop rotations, adequate spacing and orientation, not working with plants when wet, and destroying infected plant debris. Insect pests, including cabbage looper (*Tricholousia ni*), imported cabbage worm (*Pievis rapae*), and diamondback moth (*Plutella xylostella*) can be controlled by applying beneficial fungi such as *Bacillus thuringiensis* (Dipel DF™) and/

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Vegetable Planting Guide

Crop Type	Sub-Group	Average sds/unit	Direct Seed or Transplant	Ideal Soil Temp for Germination	Days to Germi-nation	Seeding Depth	Seeding Rate	Final Plant Spacing	Row Spacing	Wks From S'dling to Transplant	*Plant Hard-iness
Bean	Bush, dry	80-160/oz	DS	75-85	7-10	1-2"	8 sds/ft	2-3"	28-36"		TA
Bean	Bush, snap	80-220/oz	DS	65-75	7-10	1-2"	8 sds/ft	2-3"	18-36"		TA
Bean	Pole, snap / dry	70-120/oz	DS	65-75	7-10	1-2"	8 sds/ft	2-3"	12"		TA
Bean	Soybean	120-140/oz	DS	75-85	7-10	1-2"	8 sds/ft	2-3"	28-36"		TA
Beets		1,560/oz	DS or TP	70-80	7-14	1/4"	10 sds/ft	2-3"	12-18"	5-6	HB
Broccoli	Heading	8M/oz	DS or TP	65-75	5-10	1/4"	3 sds/ft	8-12"	18"	4-6	HB
Broccoli	Sprouting	6,875/oz	DS or TP	65-75	5-10	1/4"	2 sds/ft	24-30"	36"	4-6	HB
Brussels Sprouts		8M/oz	DS or TP	70-75	5-10	1/4"	3 sds/18"	18-24"	30"	4-6	HB
Cabbage	Chinese / Napa	8,500sds/oz	DS or TP	65-85	5-10	1/4-1/2"	3 sds/18"	12-18"	18-30"	4-6	HB
Cabbage	Fresh market	7-10M/oz	DS or TP	65-85	5-10	1/4-1/2"	2-3 sds/ft	10-18"	18-24"	4-6	HB
Cabbage	Storage	7,250/oz	DS or TP	65-85	5-10	1/4-1/2"	2-3 sds/ft	18-24"	18-34"	4-6	HB
Carrots		29M/oz	DS	65-75	10-21	1/2"	15-45 sds/ft	1-2"	18-24"		HB
Cauliflower		8,500/oz	DS or TP	65-75	5-10	1/4-1/2"	3 sds/ft	18-20"	12-18"	4-6	HB
Celeriac		65-70M/oz	TP	70-75	14-21	1/8"	NA	6-10"	24-36"	10-12	HB
Celery		65-70M/oz	TP	70-75	14-21	1/8"	NA	6-10"	24-36"	10-12	TB
Chard	Baby leaf	1,560/oz	DS	70-75	7-14	1/2"	40 sds/ft in 2-4" band	NA	3/4" b/t bands		HB
Chard	Full size	1,560/oz	DS or TP	70-75	7-14	1/2"	6 sds/ft	4-8"	18-24"	4-6	HB
Corn		75-280/oz	DS or TP	75-85	7-10	1-2"	3 sds/ft	8-10"	30-36"	3-4	TA
Cucumber	Pickling	1,100/oz	DS or TP	75-85	7-10	1/2"	6 sds/8"	8-12"	3-6'	3-4	TA
Cucumber	Slicing	750-1,100/oz	DS or TP	70-85	7-10	1/2"	2 sds/ft	12-18"	5-6'	3-4	TA
Eggplant		6,350/oz	TP	75-85	10-12	1/4"	NA	18-24"	30-36"	8-12	TA
Fennel		6,300/oz	DS or TP	60-70	14-21	1/4"	8 sds/ft	6-8"	18"	4-6	HA
Kale/ Collards	Baby leaf	7,500/oz	DS	70-75	5-10	1/4"	60 sds/ft in 2-4" band	NA	3/4" b/t bands		HB
Kale/ Collards	Full size	7,500/oz	DS or TP	70-75	5-10	1/4"	4 sds/ft	8-10"	18-30"	4-6	HB
Kohlrabi		6,500/oz	DS or TP	65-75	5-10	1/4"	12 sds/ft	4"	12-18"	4-6	HB
Leek	Summer	10M/oz	TP	65-70	10-14	1/4"	6 sds/ft	3-4"	24"	10-12	HB
Leek	Winter	10M/oz	TP	65-70	10-14	1/4"	4 sds/ft	6"	24-30"	10-12	HB
Lettuce	Baby leaf	25M/oz	DS	65-70	7-10	1/8"	60 sds/ft in 2" bands	NA	3-4" b/t bands		HA
Lettuce	Full size	25M/oz	DS or TP	65-70	7-10	1/8"	4 sds/ft	8-12"	10-12"	4-6	HA
Melon		1,125/oz	DS or TP	75-85	5-10	1/2"	3 sds/ft	12-18"	6' center beds	4-6	TA
Onion	Bunching	10M/oz	DS	75-85	10-14	1/4"	50 sds/ft in 2-3" band	NA	12-18" b/t bands		HP
Onion	Shallots	8M/oz	TP	75-85	10-14	1/4"	20 sds/ft	3-6"	18-30"	10-12	HB
Onion	Onions	7M/oz	TP	75-85	10-14	1/4"	20 sds/ft	3-6"	18-30"	10-12	HB

How to Plant:
In the greenhouse

A. Selecting Media for Seeding

1. Seed-soil contact, fine texture
2. Pore space
3. Water retention
4. Nutrient value

B. Potting Mix vs. Seed Starting Mix

1. Different texture and nutrient needs

See this publication if you are interested in mixing your own potting media.

Electronic copy on your flash drive.

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Potting Mixes for Certified Organic Production

HORTICULTURE TECHNICAL NOTE

Abstract: Organic production of seedlings, transplants, and potted plants requires the use of media that meet the requirements of the National Organic Standard. This publication lists commercial sources and provides formulas and guidance for on-farm preparation of approved media.

By George Kuepper
NCAT Agriculture Specialist
and Kevin Everett, Program Intern
September 2004
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INTRODUCTION

Farms and nurseries use various seedling and potting media in the production of field transplants, container plants, and greenhouse crops. Such media may contain a wide range of natural and synthetic materials. In certified organic production, there are limitations on the materials that may be used, either as base substrates or for supplemental fertilization. This publication will help organic producers find commercial sources of organic potting media— or make their own.

Table of Contents

INTRODUCTION 1
COMMERCIAL BLENDS 2
MAKING YOUR OWN 2
INGREDIENTS ALLOWED IN ORGANIC POTTING MEDIA 3
COMPOST AND MANURE RULES 4
APPENDIX 1: SOURCES OF ORGANIC POTTING MEDIA, UNTREATED PEAT MOSS, COIR, AND OTHER APPROVED INGREDIENTS 11
APPENDIX 2: RECOMMENDED GUIDES FOR LEARNING TO MAKE POTTING MEDIA 14
APPENDIX 3: RECIPES FOR GROWING MEDIA 15

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NCAT

How to Plant:
In the greenhouse

C. Choosing Your Planting Containers

1. Flats – plastic or wooden
2. Soil blocks
3. Plug trays
4. Plastic cell packs
5. Peat pots

How to Plant:
In the greenhouse

D. Covering Your Seeds

1. Dry media or vermiculite, 1/8 – 1/2”
2. Some small seeds don’t need to be covered

E. The Right Environment for Germination

1. Warmth - heat pad
2. Moisture - cover tray with plastic, aluminum foil, or damp newspaper or burlap
3. Light - if needed

F. After Seeds Have Emerged

1. Remove tray cover and place in light
2. Lower air temperature

At the Kerr Center

Growing Out Transplants:
Environmental conditions

A. Temperature

1. Lower than germination temp
2. Usually 70˚F to 80˚F, 10˚F lower at night

B. Light

1. Natural light – as much as possible
2. Artificial light – 16 hours under a grow light is optimal
    a. Full spectrum fluorescent bulbs

Growing Out Transplants:
Environmental conditions

C. Air Flow

1. Prevents disease buildup
2. Leads to hardier seedling
3. Passive or active cooling of greenhouse

Growing Out Transplants: *Irrigation*

Watering Your Transplants

A. System dependent on scale

B. Hand watering
   1. Check for moisture every day

C. Automated irrigation
   1. Irrigation timer
   2. Micro sprinklers

Growing Out Transplants:
Fertility

Focus on Organic Fertility in Potting Mix

A. Compost or vermicompost
B. Fertility mix, equal parts:
    1. Blood meal (N)
    2. Soft rock phosphate (P)
    3. Greensand (K)

Adding Biology to Potting Mix

A. Mycorrhizae – P, Zn, Cu, moisture
B. Rhizobium – N fixation

Growing Out Transplants: *Fertility*

Foliar Fertilizer

A. Drench foliage with liquid fertilizer in early part of morning using sprayer
B. Fish emulsion/hydrolysate (N, P)
C. Kelp extract/meal (K, hormones, vitamins)

Fertigation

A. Injecting irrigation water with liquid fertilizer
B. Use liquid fish and kelp

Growing Out Transplants:
Potting Up

Moving Seedlings to a Larger Container

A. Prevents seedling from becoming root bound
B. Encourages more root development
C. Necessary if starting seeds in flats, small soil blocks, or small plug trays
D. Wait until seedlings have first true leaves

Growing Out Transplants:
Hardening off

Preparing Seedlings To Be Planted Out

A. Gradually acclimate seedlings to field conditions
    1. Start 1 week prior to planting out
    2. Decrease watering
    3. First day spent in the shade for 1 hour
    4. Protect seedlings from strong wind and rain

Growing Out Transplants:
Hardening off

Preparing Seedlings To Be Planted Out

B. By end of week, seedlings should be adjusted to a full day in the sun

Growing Out Transplants:
Planting out

Perfect Timing

A. Before transplants become root bound or too mature
    1. Root bound tomatoes will start to flower
B. Overcast days with little wind are ideal
C. Evening is the best time of day

Growing Out Transplants:
Planting out

Easing the Transition

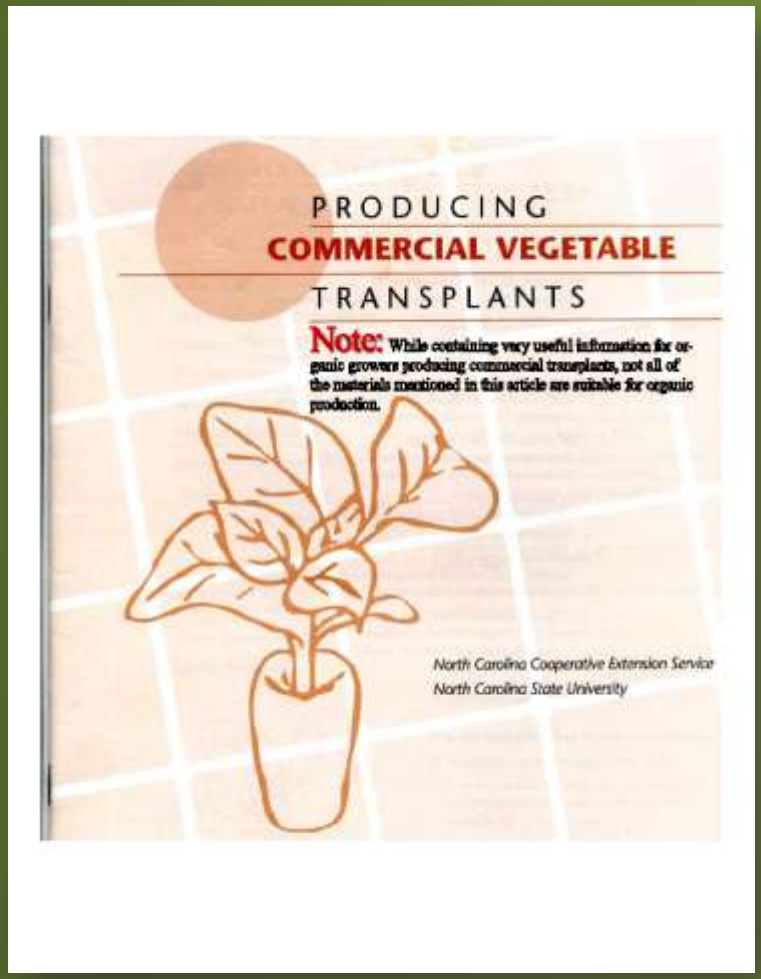
A. Mix in compost or vermicompost before planting out
B. Provide plenty of water
C. Water in with fertilizer solution to provide immediate nutrition
    1. Fish emulsion/hydrolysate
    2. Kelp extract/meal
    3. Humic acid
    4. Compost tea soil drench

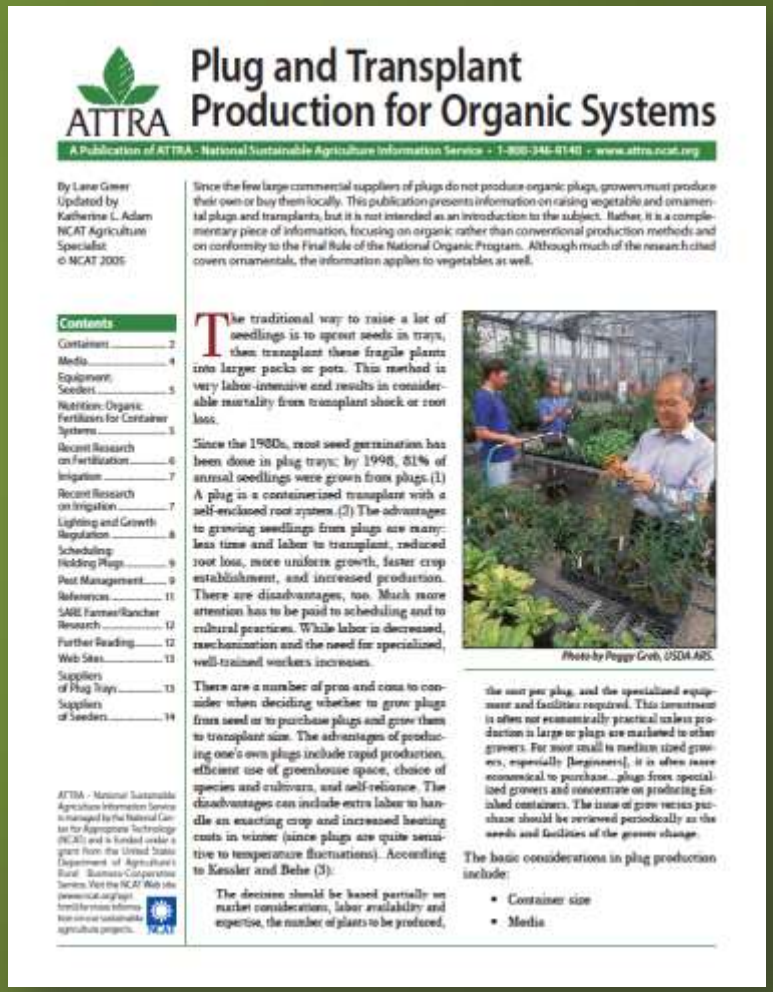
Growing Out Transplants:
Planting out

Growing Out Transplants:
Planting out

Growing Out Transplants:
Planting out

Growing Out Transplants:
Electronic Resources on Flash Drive





ATTRA

Plug and Transplant Production for Organic Systems

A Publication of ATTRA - National Sustainable Agriculture Information Service • 1-800-346-9140 • www.attra.ncat.org

By Lane Greer
Updated by
Katherine L. Adam
NCAT Agriculture Specialist
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Since the few large commercial suppliers of plugs do not produce organic plugs, growers must produce their own or buy them locally. This publication presents information on raising vegetable and ornamental plugs and transplants, but it is not intended as an introduction to the subject. Rather, it is a complementary piece of information, focusing on organic rather than conventional production methods and on conformity to the Final Rule of the National Organic Program. Although much of the research cited covers ornamentals, the information applies to vegetables as well.

Contents

Containers 2
Media 4
Equipment: Seeders 5
Nutrition: Organic Fertilizers for Container Systems 5
Recent Research on Fertilization 6
Irrigation 7
Recent Research on Irrigation 7
Lighting and Growth Regulation 8
Scheduling: Holding Plugs 9
Pest Management 9
References 11
SARE Farmer/Rancher Research 12
Further Reading 12
Web Sites 13
Suppliers of Plug Trays 13
Suppliers of Seeders 14

The traditional way to raise a lot of seedlings is to sprout seeds in trays, then transplant these fragile plants into larger packs or pots. This method is very labor-intensive and results in considerable mortality from transplant shock or root loss.

Since the 1980s, most seed germination has been done in plug trays; by 1998, 81% of annual seedlings were grown from plugs.(1) A plug is a containerized transplant with a self-enclosed root system.(2) The advantages to growing seedlings from plugs are many: less time and labor to transplant, reduced root loss, more uniform growth, faster crop establishment, and increased production. There are disadvantages, too. Much more attention has to be paid to scheduling and to cultural practices. While labor is decreased, mechanization and the need for specialized, well-trained workers increases.

There are a number of pros and cons to consider when deciding whether to grow plugs from seed or to purchase plugs and grow them to transplant size. The advantages of producing one's own plugs include rapid production, efficient use of greenhouse space, choice of species and cultivars, and self-reliance. The disadvantages can include extra labor to handle an exacting crop and increased heating costs in winter (since plugs are quite sensitive to temperature fluctuations). According to Kessler and Behe (3):

> The decision should be based partially on market considerations, labor availability and expertise, the number of plants to be produced,

Photo by Peggy Greb, USDA ARS.

the cost per plug, and the specialized equipment and facilities required. This investment is often not economically practical unless production is large or plugs are marketed to other growers. For most small to medium sized growers, especially [beginners], it is often more economical to purchase...plugs from specialized growers and concentrate on producing finished containers. The issue of grow versus purchase should be reviewed periodically as the needs and facilities of the grower change.

The basic considerations in plug production include:

- Container size
- Media

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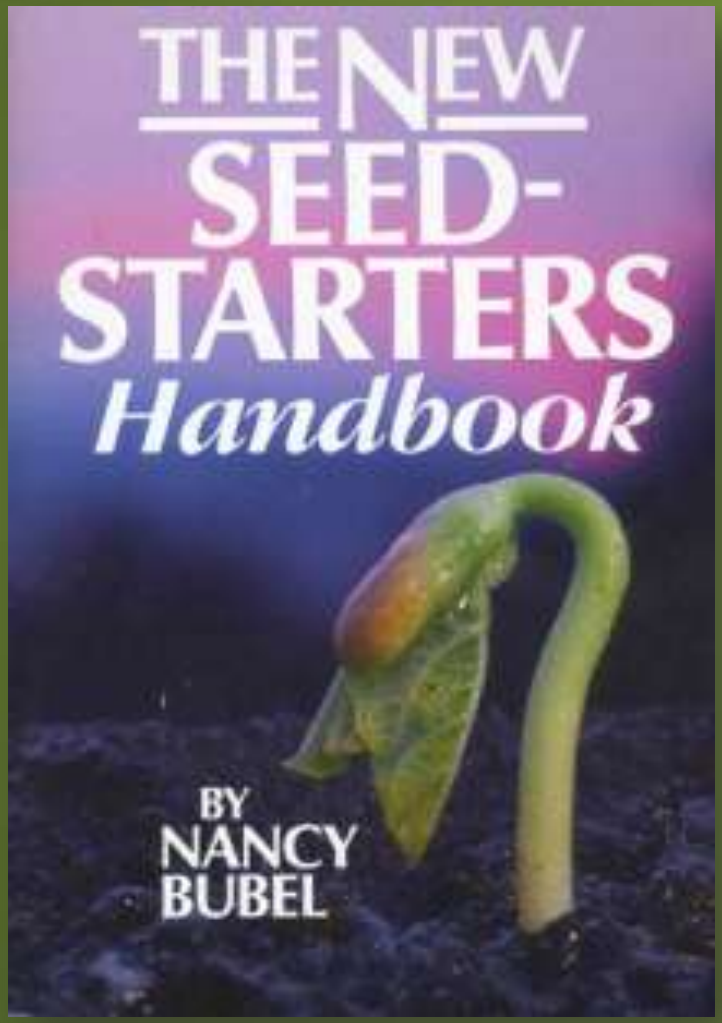
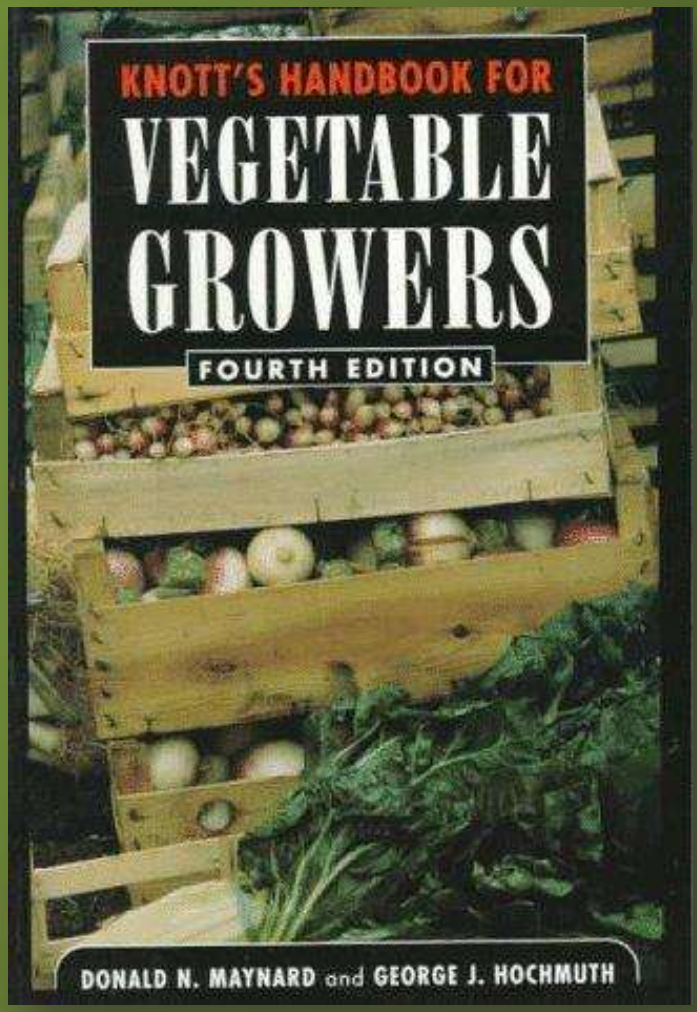
Seeds, Seeding & Transplants:
Further Reading





Happy Seeding!

Any other questions?