

Crop Management

Natural Farming / Sustainable Agriculture

By Abram J. Bicksler, Ph.D.
Stan Pittman, and Matthew Dodson

Crop Management

- ▶ Seed Preparation 备种
- ▶ Green Fertilizers and Indigenous Microbes 绿肥和土著微生物
- ▶ Crop Rotation 轮作
- ▶ Companion Planting 间作
- ▶ Natural Pest Management 自然虫害防治



Crop Management (Seeds)

Three Types of Seeds

- ▶ Open Pollinated Seeds (Heirloom) - Seeds that are capable of producing seeds that will produce seedlings just like the parent plant. These seeds have not been crossed with other plants. Pollination happens naturally. Heirloom refers to seeds that are unchanged for several generations.

老品种种子：可以再用作物产的种子种植，跟亲本无异。是通过自然授粉而成，几代后没有变异

- ▶ Hybrid Seeds - A hybrid seed is the result of cross-pollination between two genetically different parent plants. Plant breeders develop hybrids to increase disease resistance, to improve yield, or to select for special fruit characteristics such as color, flavor, or size. Seeds collected from Hybrid grown plants may not grow identical plants because the seeds can revert to an original parent.

杂交种子：用不同的品种进行授粉，来提高抗病性，提高产量，或选择特殊的果实特性，如颜色，风味，或尺寸。它的种子不能再生长成原来的亲本的样子。

- ▶ GMO Seeds - Seeds that have been genetically modified to produce various traits not normally found in the parent plants. These seeds are only available for commercial farming and the plants grown normally don't produce productive seeds.

为了提高某些品质种子的基因被改变，种子正常种植不能再产种子只能进行商业种植

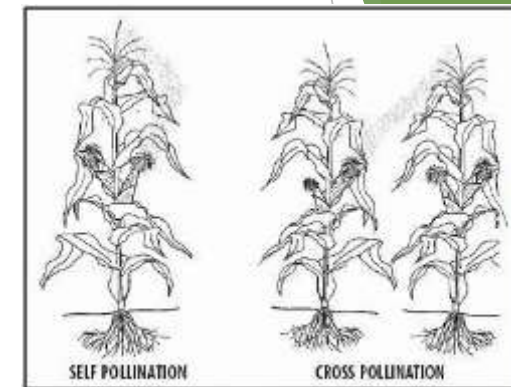
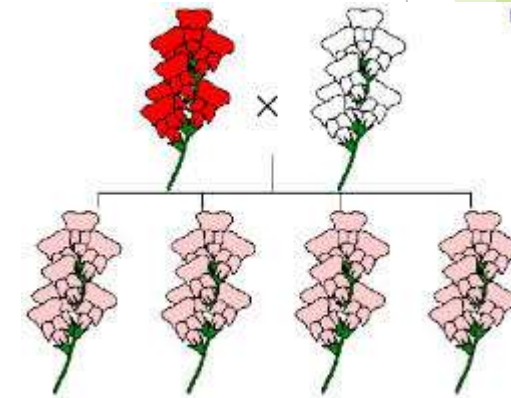





Figure 5. Self-pollination and cross-pollination.



Splicing Genes Together

Employing genetic engineering, researchers can take certain genes from a source organism and put them into another plant or animal.

An Example of Genetic Engineering:

- 1 Scientists take *Bacillus thuringiensis*, a commonly occurring soil bacteria... 
- 2 ...and use enzymes to remove from it the Bt gene, which produces a protein that turns toxic in the digestive tract of caterpillars. 
- 3 The Bt gene is then incorporated into the chromosomes of cotton and corn, killing caterpillars that feed upon these plants. 

SOURCE: North Carolina State University, College of Agriculture and Life Sciences

Crop Management (Seed Preparation)

Prepare the Seeds for Germination. 催芽

Prepares seeds for germination by soaking them in a mixture of 2 parts FPJ, 2 parts Brown rice vinegar, 1 part OHN in 1000 parts water.

把2份FPJ，2份米醋，1份OHN混合，以1000倍水稀释，把种子放在里面。

- ▶ Soak fast-germinating seeds such as turnip, cabbage and bean for 2 hours. 发芽快的如萝卜、白菜、豆2H
- ▶ Soak average-germinating seeds such as cucumber, melon, lotus and squash for 4 hours. 发芽速度一般的黄瓜、瓜、莲子、南瓜4H
- ▶ Soak slow-germinating seeds such as rice, barley and tomato for 7 hours. 发芽慢的：水稻、薏米、西红柿7H
- ▶ Soak other seeds such as potato, ginger, garlic and taro for .5-1 hours. 块茎类的土豆、姜、蒜、芋头0.5-1H



Crop Management (Seed Germination)

Prepare the Seeds for Germination.

Once the seeds have been soaked in the germination solution then they can be directly sown in the soil or germinated in containers. If you are germinated in containers it is best to sterilize the soil before planting.

种子一旦在溶液中浸过就要种在地里或是育苗钵里。育苗钵里的土在种植前最好是消毒过的

Sterilizing the soil to be used for the seed box or in rolled banana leaf will reduce the number of diseased organisms in the soil that damage the newly-sprouted seedlings. The following are methods of soil sterilization:

放在育苗钵和用香蕉叶卷起来的小杯里的都要消毒过的，这样可以杀死土壤的害虫以保护幼苗生长。下面是几种消毒的

Methods for sterilizing

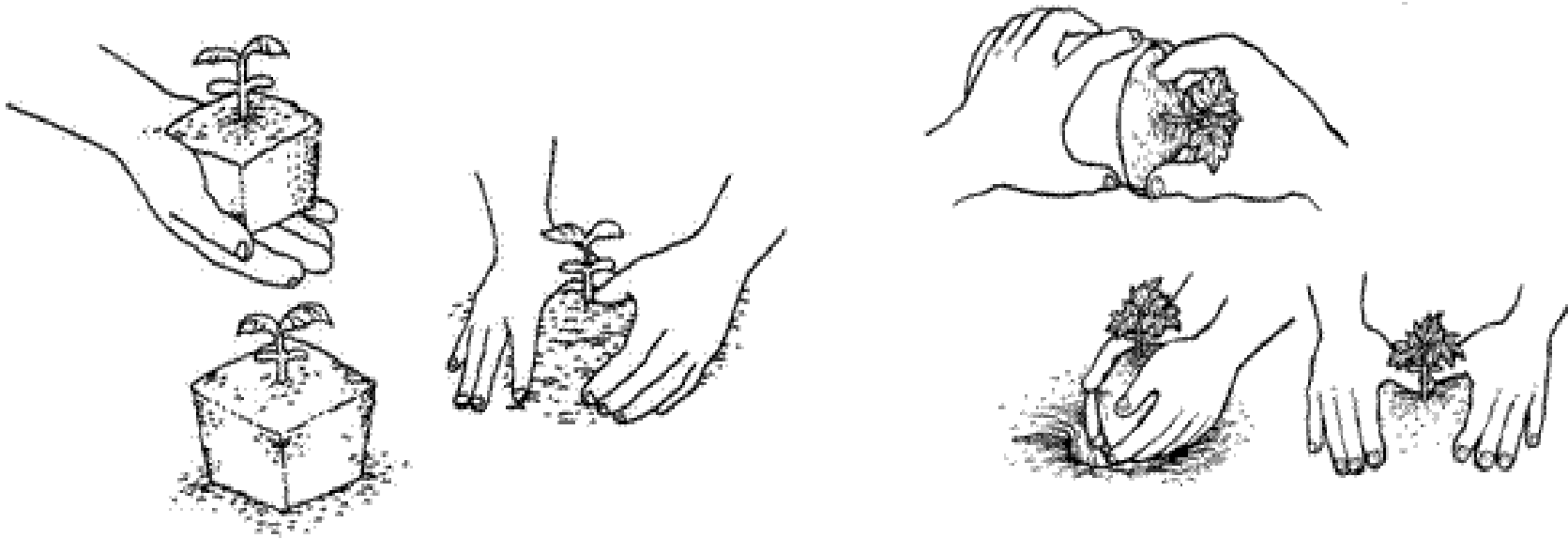
- ▶ Sun-drying the soil for the whole day. 暴晒一天
- ▶ “Baking” the soil in the oven for three (3) hours at 85 to 95C. 把土加热到85-95度，3H
- ▶ Hot water treatment (Pouring boiling water of dirt) 热水法（用开水烫）
- ▶ Using plant leaves (e.g. malungay/moringa and madre de cacao) as sterilizing agent. 用植物叶子作消毒材料（辣木）



Crop Management (Seed Transplanting)

Transplanting is moving seedlings from the seed-box to the garden beds.
Transplant seedlings having five (5) true leaves. It should be done late in the afternoon.

当有5个真叶的时候要把植物移栽到苗床里，最好在下午进行。

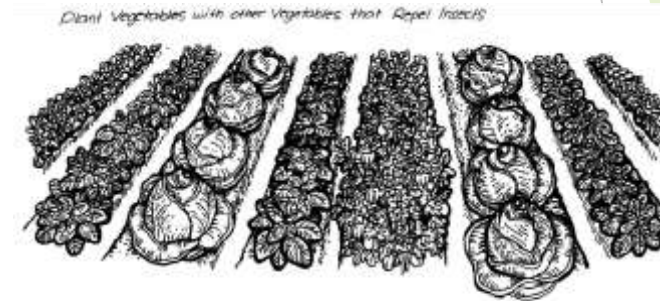


Crop Management (Companion Cropping)

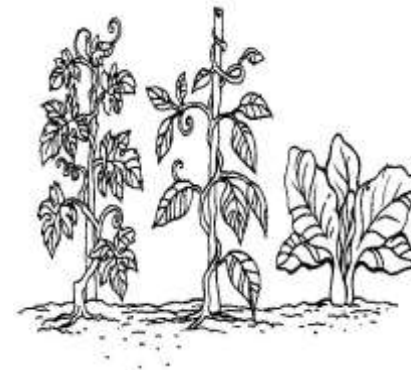
Companion gardening - Companion gardening is planting of different crops close to each other so they will be able to help one another. Planting of herbs and other plants repels and inhibits growth of pest on the garden with the crops. Such as orange grass, marigold (for the control of nematodes).

伴生种植：把不同的作物按不同的间距种在一起，一些药性作物可以抑制和防止害虫滋生。
例如：万寿菊可以防止地里的线虫

Crop	Companion Herb
Tomato, Sweet Pepper, Okra 番茄, 秋葵	Basil, Parsley 九层塔, 香菜
Carrots 胡萝卜	Chives, Leek, Onion 小葱, 韭菜, 洋葱
Onion, Celery, Carrots 洋葱, 芹菜, 胡萝卜	Leek 韭菜
Tomato, Beet, Lettuce 番茄, 甜菜, 莴苣	Onion, Garlic 洋葱,
Cauliflower 花椰菜	Celery 芹菜



© Cabbage
Tomato
Mint



© Beans &
Leafy Vegetables

- Crop
- Tomato, Sweet Pepper
 - Carrots
 - Onion, Celery, Carrot
 - Tomato, Beet, Lettuce
 - Potato, other Root
 - Vines and other veg
 - Cabbage, Green Mu
 - Cauliflower
 - Cucumber
 - Asparagus
 - Beans
 - Beets
 - Broccoli, Leek
 - Melons
 - Pumpkin

Crop Management (Companion Cropping)

Crop	Plant near (Companions)	Do Not Plant Near
Basil	Tomatoes	Rue
Beans	Tomatoes, Corn, Celery, Cucumbers	Onions, Garlic, Shallots, Chives, Sunflowers
Beets	Mint, Catnip, Onions, Kohlrabi	Pole Beans, Mustard
Broccoli	Beans, Celery, Potatoes, Onions, Beets, Marigold, Sage, Nasturtiums	Tomatoes
Cabbage	Kale, Sage, Thyme, Pennyroyal, Clover, Lettuce	Strawberries, Grapes
Carrots	Radishes, Peas, Sage, Onions, Leeks, Chives	Dill, Anise
Chives	Carrots, Grapes, Tomatoes	Beans, Peas
Corn	Beans (can climb corn stalks), Sunflowers, Squash, Pumpkins	None Known
Cucumber	Cabbage, Broccoli, Cauliflower	Potatoes, Aromatic Herbs
Dill	Cabbage, Lettuce, Onions, Cucumbers	Carrots
Eggplant	Green Beans, Lettuce, Kale, Basil, Garlic	None Known
Garlic	Tomatoes, Eggplant, Cabbage	Peas, Beans, Legumes
Kale	Dill, Mint, Sage, Rosemary, Cabbage,	Grapes, Strawberries, Tomatoes
Lettuce	Strawberries, Carrots, Cucumbers, Cabbage, Beets, Radishes, Broccoli, Tomatoes	None Known
Onion	Potatoes, Carrots, Tomatoes, Broccoli, Beets, Dill	Peas, Beans, Sage
Pea	Tomatoes, Eggplant, Lettuce, Radishes, Carrots, Cucumbers, Turnips, Corn, Beans	Onions, Garlic
Peppers	Okra, Tomatoes,	Kohlrabi, Fennel, Beans,
Potatoes	Lettuce, Radishes, Green Onions,	Raspberries, Pumpkins, Tomatoes, Squash, Cucumbers, Sunfl
Pumpkins	Corn, Beans, Sunflowers	Raspberries, Potatoes
Radishes	Peas, Lettuce, Beans, Carrots, Kohlrabi, Onions	Grapes, Hyssop
Spinach	Celery, Eggplants, Cabbage, Peas, Onions	None Known
Squash	Radishes, Mint, Corn, Sunflowers,	Potatoes
Strawberries	Plant under Peach trees	Cabbage
Tomato	Dill, Borage, Basil, Onions, Beans, Spinach, Lettuce	Black Walnut, Fennel, Potatoes

Mutually beneficial plant combinations
according to current reports taken
from Organic Gardening and Farming.

COMPANION PLANTS CHART

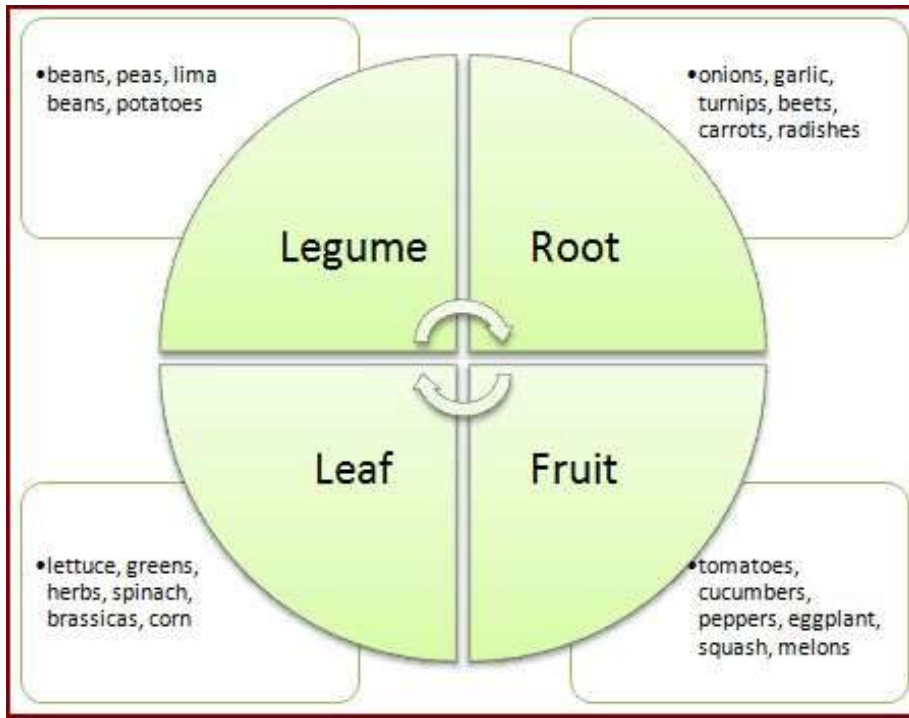
PLANT	COMPANIONS / EFFECTS	PLANT	COMPANIONS / EFFECTS	PLANT	COMPANIONS / EFFECTS	PLANT	COMPANIONS / EFFECTS
<i>Asparagus</i>	Tomatoes, parsley, basil.	<i>Chervil</i>	Radishes (improves growth and flavor).	<i>Marjoram</i>	Here and there in garden.	<i>Rue</i>	Roses and raspberries; deters Japanese beetle. Keep it away from basil.
<i>Basil</i>	Tomatoes (improves growth and flavor); said to dislike rue; repels flies and mosquitoes.	<i>Chives</i>	Carrots; plant around base of fruit trees to discourage insects from climbing trunk.	<i>Mint</i>	Cabbage family & tomatoes, deters cabbage moth.	<i>Sage</i>	Rosemary, carrots, cabbage, peas & beans; deters some insects.
<i>Beans</i>	Potatoes, carrots, cucumber, cauliflower, cabbage, summer savory, most other vegetables and herbs, & around houseplants when set outside.	<i>Corn</i>	Potatoes, peas, beans, cucumbers, pumpkin & squash.	<i>Nasturtium</i>	Tomatoes, radishes, cabbage, cucumbers; plant under fruit trees; deters aphids and pest of cucurbits.	<i>Southern-wood</i>	Cabbage; plant here and there in garden.
<i>Beans (bush)</i>	Sunflowers (beans like partial shade, sunflowers attract birds and bees), cucumbers (combination of heavy and light feeders), potatoes, corn, celery, summer savory.	<i>Cucumbers</i>	Beans, corn, peas, radishes, & sunflower.	<i>Onion</i>	Beets, strawberries, tomato, lettuce (protects against slugs), beans (protects against ants), summer savory.	<i>Soybeans</i>	Grows with anything, helps everything.
<i>Beets</i>	Onions & kohlrabi.	<i>Dill</i>	Cabbage (improves growth and health), carrots.	<i>Parsley</i>	Tomato & asparagus.	<i>Spinach</i>	Strawberries.
<i>Borage</i>	Tomatoes (attract bees, deters tomato worm, improves growth, & flavor), squash, strawberries.	<i>Eggplant</i>	Beans.	<i>Peas</i>	Squash (when squash follows peas up trellis); grows well with almost any vegetable; adds nitrogen to the soil.	<i>Squash</i>	Bean &, onions; deters bean beetles.
<i>Cabbage family</i>	Potatoes, celery, camomile, sage, thyme, mint, rosemary, lavender, beet & onions.	<i>Fennel</i>	Most plants dislike it.	<i>Petunia</i>	Protects beans, beneficial throughout the garden.	<i>Strawberries</i>	Bush beans, spinach, borage, lettuce (as border).
<i>Carrots</i>	Peas, lettuce, chives, onions, leeks, rosemary, sage & tomatoes.	<i>Flax</i>	Carrots & potatoes.	<i>Pot Marigold</i>	Helps tomato, but plant throughout garden as deterrent to asparagus beetle, tomato worm and many other garden pests.	<i>Summer Savory</i>	Beans, onions; deters bean beetles.
<i>Catnip</i>	Plant in borders; protects against flea beetles.	<i>Garlic</i>	Rose and raspberries (deters Japanese beetle); helps herbs with their production of essential oils, plant liberally throughout garden to deter pests.	<i>Pumpkin</i>	Corn.	<i>Sunflower</i>	Cucumbers.
<i>Celery</i>	Leeks, tomatoes, bush beans, cauliflower & cabbage.	<i>Geraniums</i>	Near grapes (discourages Japanese beetles).	<i>Radish</i>	Peas, nasturtium, lettuce, cucumbers; as a general aid in repelling insects.	<i>Tansy</i>	Plant under fruit trees; deters pest of roses and raspberries; deters flying insects; also Japanese beetles.
<i>Camomile</i>	Cabbage & onions.	<i>Horseradish</i>	Potatoes (deters potato beetle), around plum trees to discourage curculios.	<i>Rosemary</i>	Carrots, beans, cabbage, sage; deters cabbage moth, bean beetles and carrot fly.	<i>Tarragon</i>	Good throughout garden.
		<i>Leek</i>	Onions, celery & carrots.			<i>Thyme</i>	Chives, onion, parsley, asparagus, marigold, nasturtium, carrots & limas.
		<i>Marigolds</i>	The workhorse of pest deterrents! Keeps soil free of nematodes; discourages many insects. Plant freely throughout the garden.			<i>Turnip</i>	Peas.

Combination of vegetables, herbs, flowers and weeds that are **mutually beneficial**, according to current reports compiled from Organic Gardening and Farming.

Crop Management (Crop Rotation)

Crop Rotation - Crop rotation is one of the oldest and most effective pest and disease control strategies. Growing a single crop year after year in the same field gives pest populations sufficient time to become established and build up to damaging levels. Rotating the field to a different type of crop can break this cycle by starving pests that cannot adapt to a different host plant.

轮作是最古老和最有效的病虫害防治策略之一，常年种植一种作物会给害虫充分时间来营造它滋生的环境，对作物产生损害。轮作可以打破宿主生长的循环，使害虫不再繁殖。



Crop Management (Pest Management)

Pest management: In addition to Crop rotation and companion planting you can apply some natural biological and physical pest deterrents.

除了轮作和伴生作物还有一些天敌生物

Insects/Pest	Ingredients	Mixture and Usage
Termites, aphids, beetle, weevil, cutworm, ants, bugs	Leaves/stem of fish bean/moringa 1 part leaves/stem 5 parts water, spoonful soap	Crushed , strain mix with water for spray. Use for bathing animals to eliminate bugs.
Beetles and worm	Ash	Spread ash to the whole plant, stem and leaves
Mouse	Mouse Trap	Get a pail of kerosene can
Various Insects	1 part molasses for 50 part of water	Spray
Various Insects	Seeds and leaves of neem	Seed treatment: Mix the powder from pulverized neem seeds for storage to prevent being eaten by insects and rats.
Snails and slugs	Ginger Powder	Spread ginger powder on soil around the plants. It's sharp burning taste protect the plants
Tomato Pests		Pinch tomato leaves to ward off tomato pest. By bruising or wounding , the tomato plant leaf activates hormones that causes insect attacking the plants to die severe indigestion
Nematodes	Neem leaves	Before planting: Mix the crushed leaves on soil Pesticide: dry the leaves in shade. Crushed dry leaves and spread like ash in the plants Spray
Slugs and cutworms	Mulch Crushed eggshells	Mulch around the plants A ring of crushed eggshells does double duty around young plants. The sharp, crushed shells repel hungry slugs and cut worms while adding calcium to the soil.
Cut worms, slugs and white fly	1/3 chop garlic	Soak garlic in mineral oil for 24 hours

Crop Management (Planting Calendar)

A Garden Planting Chart WARM SEASON VEGETABLES

Crop	Seeds/plants Per 100'	Spacing (inches) Plants	Seed depth (inches)	Zone 9	Zone 10	Zone 10b
Beans, bush	1 lb.	2-3	1-2	Mar-Apr Aug-Sept	Feb-Apr Sept	Sept-Apr
Beans, pole	½ lb.	3-6	1-2	Mar-Apr Aug-Sept	Feb-Apr Aug-Sept	Aug-Apr
Beans, lima	2 lb.	3-4	1-2	Mar-Aug	Feb-Apr Sept.	Aug-Apr
Cantaloupe	½ oz.	24-36	1-2	Mar-Apr	Feb-Apr	Aug-Sept Feb-Mar
Corn, sweet	2 oz.	12-18	1-2	Mar-Apr Aug	Feb-Mar Aug-Sept	Aug-Mar
Cucumbers	½ oz.	12-24	1-2	Feb-Apr Aug-Sept	Feb-Mar Sept	Sept-Mar
Eggplant	50 plants 1 pkt	24-36	½	Feb-July	Jan-Mar Aug-Sept	Dec-Feb Aug-Oct
Peas, southern	½ oz.	2-3	1-2	Mar-Aug	Mar-Sept	Aug-Apr
Peppers	100 plants 1 pkt	12-24	½	Feb-Apr July-Aug	Jan-Mar Aug-Sept	Aug-Mar
Potatoes, sweet	100 plants	12-14	---	Mar-June	Feb-June	Feb-June
Pumpkin	1 oz.	36-60	1-2	Mar-Apr Aug	Feb-Mar Aug	Jan-Feb Aug-Sept
Squash, Summer	1½ oz.	24-36	1-2	Mar-Apr Aug-Sept	Feb-Mar Aug-Sept	Jan-Mar Sept-Oct
Squash, Winter	1 oz.	36-48	1-2	Mar-Aug	Feb-Mar Aug	Jan-Feb Sept

Crop Management (Planting Calendar)

COOL SEASON VEGETABLES						
Beets	1 oz.	3-5	½ - 1	Sept-Mar	Oct-Mar	Oct-Feb
Broccoli	100 plts 1/8 oz.	12-18	½ - 1	Aug-Feb	Aug-Jan	Sept-Jan
Brussels Sprouts	100 plts 1/8 oz	18	½ - 1	Sept-Nov	Oct-Nov	Oct-Dec
Cabbage	(1/8 oz) 100 plts	12-24	½ - 1	Sept-Feb	Sept-Jan	Sept-Jan
Carrots	1/8 oz.	1-3	½	Sept-Mar	Oct-Mar	Oct-Feb
Cauliflower	55 plts (1/8 oz)	18-24	½ - 1	Jan-Feb Aug-Oct	Oct-Jan	Oct-Jan
Celery	150 plts (1/8 oz)	6-10	¼ - ½	Jan-Mar	Aug-Feb	Oct-Jan
Chinese cabbage	125 plts (1/8 oz)	12-24	¼ - ¾	Oct-Feb	Oct-Jan	Nov-Jan
Collards	100 plts (1/8 oz)	10-18	½ - 1	Feb-Apr Aug-Nov	Aug-Mar	Aug-Feb

Crop Management (Planting Calendar)

Endive/Escarole	100 plts	8-12	½	Feb-MarSept	Jan-FebSept	Sept-Jan
Kale	100 plts(1/8 oz)	12-18	½ - 1	Sept-Feb	Sept-Jan	Sept-Jan
Kohlrabi	1/8 oz.	3-5	½ - 1	Sept-Mar	Oct-Mar	Oct-Feb
Leek	½ oz.	2-4	½	Sept-Mar	Sept-Feb	Oct-Jan
Lettuce: Crisp, Butter-head, Leaf & Romaine	100 plts	8-12	½	Feb-MarSept-Oct	Sept-Mar	Sept-Jan
Mustard	¼ oz.	1-6	½ - 1	Sept-May	Sept-Mar	Sept-Mar
Onions, Bulbing	300 plts or sets, 1 oz seed	4-6	½ - 1	Sept-Dec	Sept-Dec	Sept-Nov
Onions, Bunching	800 plts or sets, 1 - 1½ oz seed	1-2	2-3	Aug-Mar	Aug-Mar	Sept-Mar
Onions, Multipliers	"	6-8	½ - ¾	"	"	"
Parsley	¼ oz.	8-12	¼	Sept-Mar	Oct-Feb	Sept-Jan
Peas, English	1 lb.	2-3	1-2	Jan-Mar	Sept-Mar	Sept-Feb
Potatoes	15 lbs.	8-12	3-4	Jan-Mar	Jan-Feb	Sept-Jan
Radish	1 oz.	1-2	¾	Sept-Mar	Sept-Mar	Oct-Mar
Spinach	1 oz.	3-5	¾	Oct-Nov	Oct-Nov	Oct-Jan
Strawberry	100 plts	10-14	---	Oct-Nov	Oct-Nov	Oct-Nov

Crop Management (Soil and plant enhancers)

- ▶ Fertilizer and plant enhancer's 植物增强剂
 - ▶ IMO - Indigenous Microorganisms 土著微生物
 - ▶ FPJ - Fermented Plant Juice 发酵植物汁
 - ▶ FAA - Fish Amino Acids 鱼类氨基酸
 - ▶ CAP04 - Calcium Phosphate 磷酸钙
 - ▶ CA - Calcium 钙
- ▶ Pesticides and Fungicides 杀虫杀菌剂
 - ▶ OHN - Oriental Herbal Nutrient 中药营养液
 - ▶ LABS - Lactic Acid Bacteria Serum 乳酸菌
- ▶ Fruit Enhancer 水果增强液
 - ▶ FFJ - Fermented Fruit Juice 发酵水果汁