

nutrients from entrapment in the plant matrix.

- **Fermentation** improves protein quality and digestibility, vitamin B content, and microbiological safety and keeping quality.
- **Germination/malting** increases B vitamins, facilitates iron absorption, increases vitamin C and digestibility factor and inhibits anti-nutritional factors.

Vegetables: Food for health

- Vegetables are powerful allies in the fight against diseases.
- Spinach, mustard greens, lettuce, turnip greens and bell peppers prevent colon, lung, skin, oral, stomach, ovarian, prostate, and breast cancers.
- Vitamin A in green leafy vegetables, Vitamin C in brassicas, tomatoes and peppers inhibits growth of carcinomas.
- Most-touted cancer-fighting vegetable - broccoli; Shallots, yellow onions help prevent liver and colon cancer
- Flavanoids in onions and alliums, all forms of beans and legumes, broccoli, garlic, kale, and soy foods help against heart disease and diabetes.
- Vitamins A, C, E, and B6, as well as the phytochemicals in vegetables, help alleviate the airway inflammation and damaged lung tissue found in asthma and respiratory disease.
- Yellow and orange vegetables, including bell peppers and corn, rich in antioxidants help fight arthritis.
- Eating foods rich in the carotenoids lutein and zeaxanthin - including spinach, kale, collards, turnip greens, orange bell peppers, and corn - decreases the incidence of macular degeneration and cataracts.
- Thus, vegetables are a critical, irreplaceable dietary component which break the deficiency cycle and produce healthy populations able to work and learn.

For further information on home gardening, please write to:

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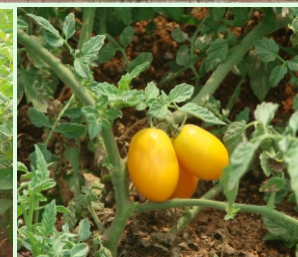
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MCSHVF

Madan Chadha Safe Healthy Vegetable Foundation



A concise guide to "Home Gardening"

**Madan Chadha Safe Healthy
Vegetable Foundation (MCSHVF)**

Home garden is basically an area around the home where different vegetables and fruit are grown throughout the year to meet the family nutritional requirements. These not only provide continuous supply of fresh nutritious vegetables for the family, but also serve as supplementary sources of additional income. In many regions the rural population subsists on starchy staple plants, ignoring vitamin-rich foods such as vegetables, particularly green vegetables; this contributes to micro-nutrient deficiency and further results in severe disease, especially in young, pregnant women, and children. Home gardens provide poor rural households, and increasingly those in peri-urban and urban areas, with ready access to diverse, fresh foods, and supply much-needed macro- and micro-nutrients to

Characteristics of a home garden

- Occupy a “small” area (scattered or fixed)
- Proximity to the home
- Include diverse vegetables
- Year round availability of vegetables
- Garden production is supplemental, rather than a main source of family consumption or income
- Easily accessible to the poor
- Easily managed by household members
- Low-cost inputs
- Utilization of indigenous vegetables rather than depending entirely on exotic varieties

Importance of home gardening

- Increases the daily consumption of safe vegetables because of avoiding the use of artificial chemicals and pesticides in the garden
- Easy to grow and maintain; in any place big or small
- Families with home gardens at a lesser risk of xerophthalmia, night blindness and other problems associated with Vitamin A deficiency
- Can be a source of hard-to-find vegetables such as kohlrabi, chinese cabbage, pak choi, chuk etc.
- Gardening can be a great, low-impact exercise
- Home garden can be an escape from stress and an ideal place for relaxation; source of cheapest, healthiest, keenest pleasure.

“Better food, better health, better living--all these the home garden offers in abundance”

Ideal cooking for home garden vegetables

• Important facts:

- Method of cooking used should be safe, easy and prevent loss of nutrients.
- The recipe prepared should ensure high bioavailability of the nutrients
- The recipe prepared should be balanced and nutritionally rich
- The recipe should be appealing, tasty and provide variety

• Cooking methods:

• Moist Heat

Boiling
Stewing
Steaming
Pressure Cooking
Poaching
Blanching

• Dry Heat

Roasting
Grilling
Toasting
Baking
Sauteeing
Frying



• Nutrient loss:

- Water soluble vitamins are lost in discarded water of boiling method – cook in less water and do not discard excess water
- Fat soluble vitamins are lost when more fat / oil is used for cooking – cook with very little oil and avoid deep fat frying

• Factors affecting nutrient loss:

Nutrient	Heat	Air	Water	Fat
Vitamin A	X			X
Vitamin D				X
Vitamin E	X	X		X
Vitamin C	X	X	X	
Thiamin	X		X	
Riboflavin			X	
Vitamin B6	X	X	X	
Folic acid	X	X		
Vitamin B12	X		X	
Biotin			X	
Pantothenic acid	X			
Potassium			X	

• Preserving nutrients:

- Cut vegetables into medium or large pieces or cook whole
- Put a lid on the pot to retain steam
- Minimize the amount of water used
- Have the water boiling before adding the vegetables
- Minimize the cooking time

• Bioavailability of nutrients:

includes in a single concept the effect of a sequence of metabolic events:

digestibility, solubilization, absorption, organ uptake and release, enzymatic transformation, secretion and excretion.

• Enhancing bioavailability of nutrients:

- **Mechanical processing** of vegetables helps to improve the bioavailability of carotenoids
- **Thermal processing** destroys anti-nutritional factors and releases

- **Roguing:** removal of plants which are off-type i.e. phenotypically different from the plants of the variety under certification.
- The off-type plants may differ in plant height, leaf characters, flowering time, maturity etc.
- Important aspect of seed production and is necessary to prevent out crossing and mechanical mixture.

Vegetables	Maturity Indices
Garden bean	Pods mature and yellow
Cowpea	Two-thirds of pods turn brown
Dolichos bean	Pods dry and yellow
Garden pea	Seeds fully developed and hard red ripe
Pepper	Ripe or ripening
Tomato	Beyond edible stage
Eggplant	White fluff (30-50%) on heads
Lettuce	Seeds dark brown in color
Cabbage	Pods dark brown in color
Cauliflower	Pods turning brown
Watermelon	Edible maturity
Cucumber	Fruit pale yellow/golden

- **Seed cleaning:** done mainly by winnowing and by gravity separation using a bamboo winnowing tray.
- **Seed drying** increases longevity, viability of the seed and facilitates storing, removes excess moisture that causes excessive respiration, heating and fungal invasion.
- The mature fruits must be harvested and air-dried immediately under the shade or under the sun whenever possible.
- Hanging the wet fruits/pods above the wood stove can help hasten drying and may prevent insect pest infestation.
- When seeds are dried and cleaned, they have to be stored properly before planting.
- Seed moisture content and storage temperature should not be too high as they cause seed deterioration and affect seed viability in storage.
- Paper and cloth bags – for short term storage.
- Bottles, tins and glass jars with tightly fitting lids or stoppers and some silica gel can be used for long term storage.
- Store the seed in a cool, shady and dry place not directly over the cooking place or in direct sunlight.



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Types and designs of a home garden

Home gardens can be:

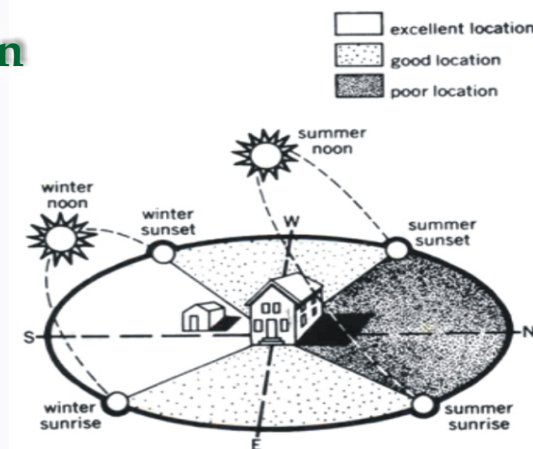
- in a small piece of land-generally back yard some times front yard.
- on the verandah using special growing containers-plastic pots, plastic bags, clay pots or other convenient containers for vegetable growing: **container gardening**.
- on roof tops: with soil placed on the cemented floor and other containers as in verandah: **terrace gardening**
- some times located little far away from home depending upon the availability of land, water and other facilities.
- a single piece of land gardened collectively by a group of people: **community gardening**.
- providing a support structure to allow vegetables to grow vertically: **vertical/hanging gardens**.
- growing vegetables using mineral nutrient solutions, without soil: **hydroponics**.



Planning a home garden

Regardless of size, there are five factors to consider in selection a garden site:

- Sunlight
- Nearness to the house
- Soil
- Water
- Good air drainage
- Shelter



Best location: Southern facing

Sunlight:

- The garden should receive at least 6 hours of direct sunlight each day; **8 to 10 hours** each day is **ideal**.
- Vegetables should be planted away from the shade of buildings, trees, and shrubs.
- The "earliest" spot should be picked up--a plot sloping a little to the south or east, that seems to catch sunshine early and hold it late, and that seems to be out of the direct path of the north and northeast winds.
- Care should be taken for some leafy vegetables such as broccoli, collards, spinach, mint, and lettuce that tolerate shadier conditions than other vegetables.

**Nearness to the house:**

- The closer the vegetable garden, easier and more frequent to use it.
- Vegetables can be harvested at their peaks and thus families can get maximum advantages of garden freshness.
- Jobs such as weeding, watering, insect and disease control, and succession planting can be well monitored if the garden is close by.

**Soil:**

- The soil should be fertile and easy to till, with just the right texture -- a **rich, sandy, light, well-drained loam**.
- "**Rich**" - full of plant food ready to be used at once
- "**Sandy**" - containing enough particles of sand so that water will pass through it without leaving it pasty and sticky a few days after a rain;
- "**Light**" - a handful, under ordinary conditions, will crumble and fall apart readily after being pressed in the hand.
- "**Loam: a rich, friable soil**," - sand and clay are in proper proportions, so that neither greatly predominate, and usually dark in color, from cultivation and enrichment.

**Water:**

- Including rain and irrigation, the garden needs at least **1 inch** of water **per week**.
- It is essential to locate the garden near a spigot or some other water source.

**Good air drainage:**

- Vegetable gardens should be avoided in a low spot such as the base of a hill or the foot of a slope.

- The shelf life of pickles is more and seasonal vegetables can be pickled to make it available in the off-season too.
- Sauces can be made with vegetables like tomato, mint and mustard and stored for long time. They are made with spices, salt and sugar is also added to get the sweet sour taste.

**Seed production at home garden level**

- Seeds should be saved from healthy, vigorous plants only.
- The plants from which seeds are to be saved should be marked and observed during their whole growth period.
- No seeds should be extracted from diseased and/or pest-infected plants. Undesirable plants should be removed and eaten by the household.
- If large amounts of seed are required, a plot should be reserved for seed production alone, in isolation from other similar crops.
- Harvest the selected plant at the proper stage of maturity depending on the type
- Extract the seed from the fruit/pod using the appropriate technique
- Collect seeds in the dry season rather than the wet season. This avoids problems with disease
- Collect seeds on a dry, sunny day if possible
- Extract seeds in a clean and empty area to avoid accidental inclusion of non-selected plants.
- **Isolation distance** for keeping seeds pure:
 - **Self-pollinated crops:** 25 to 50 m distance to avoid mechanical mixture at the time of planting or harvest.
 - **Cross-pollinated crops:** isolation of 400 to 1600 m depending upon the amount and type of out crossing.



- **Bagging:** when only a small amount of seed is needed, the unopened flowers can be covered with a paper bag.
- Applicable for crops with a high but not 100% rate of self-pollination, such as pepper, eggplant and cucurbits.

- **Caging:** vegetables that flower over a long time or to prevent insects from transmitting pollen from two nearby varieties of the same crop.
- Hand pollination needed to ensure seed set, or introduce bees into the cage if crops are cross-pollinated.



- Processing (canning, drying, freezing, and preparation of juices, jams, and jellies) increases the shelf life of fruits and vegetables and the nutrients present in vegetables are available on a long term.
- Processing steps include preparation of the raw material (cleaning, trimming, and peeling) followed by cooking, canning, or freezing.
- **Methods of reducing food deterioration:**
 - **Physical:** Heating, cooling, drying/dehydration, concentration, sterilising, irradiation, other physical means (high pressure, vacuum, inert gases)
 - **Chemical:** Salting, smoking, sugar addition, artificial acidification
 - **Biochemical:** Lactic fermentation
- Freezing is a fast and easy way to preserve the vegetables
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- Advantages of freezing vegetables:
 - retains 100% of the vitamin C in vegetables
 - the color, flavor and texture of frozen vegetables is more like fresh than other preservation methods
 - it is quick and easy
 - doesn't require specialized freezing equipment
- Only good quality vegetables that are on the young side should be frozen; larger vegetables are better canned
- Squeeze air out of plastic freezer bags: air promotes oxidation and freezer burn, affecting vegetable quality
- Most vegetables should be **blanched** (immersed in boiling water) before freezing.
- Blanching destroys enzymes that affect the vegetable's flavor, color and texture, thereby keeping the vegetables fresh.
- **Canning:** preserving vegetables by sealing in airtight cans or jars.
- To the home gardener: only glass jars are practical.
- In home canning, food is heated - or processed - for a specified time in a closed jar and hermetically sealed with a two-piece cap.
- Heating the jar expels air and halts decay. As the jar cools, the lid seals onto the rim and creates a vacuum.
- **Pickling:** vegetables are prepared with salt and spices after which they are stored in cans or bottles or jars.



- These should preferably be located on high ground where they are more likely to escape light freezes, permitting an earlier start in the spring and a longer harvest in the fall.

Shelter:

- Vegetable crops can be severely affected in windy sites; even light winds may reduce yields by 25%.
- A series of windbreaks should be set to baffle and filter the wind if the vegetable garden site is exposed.
- Any windbreak should be 50% permeable;
- Solid barriers should be avoided.



Size and shape of a home garden

- Size depends on area available, how big the family is, what vegetables are to be grown, water availability during dry spells, and how much time can be spent in the home garden.
- Shape of the garden could be circular, squarish, angular or rectangular.
- Most acceptable is the **rectangular** shape: more convenient to work and easy to keep it neat and clean.
- Crop rotation should be practiced for maximum benefits

Climatic conditions affecting a home garden

Temperature:

- Temperatures, both high and low, affect growth, flowering, pollination, and the development of fruits.
- Temperature too high or too low: leafy crops may be forced to flower prematurely without producing the desired edible foliage- "going to seed". Crops affected: cabbages and lettuce.
- Night temperature too cool: fruiting crops drop their flowers reducing yields considerably, Crop affected: peppers.
- **Ideal temperatures for vegetable plant growth are between 5° and 29°C.**

Rainfall:

- Amount and timing of the rainfall affects how the vegetables grow.
- Too much rain at one time can wash away seeds or young seedlings and damage or even kill mature plants.
- A constant rain when certain plants are flowering can reduce the pollination of the flowers and reduce yields.
- Too little rain and limited moisture over a period of time can slow down plant growth, kill young seedlings or even mature plants and also inhibit pollination thus reducing the yields of some vegetables.

Day length:

- **Long day vegetables:** need 12 or more hours of sunlight daily in order to initiate flowering. E.g. radish, spinach.
- **Short day vegetables:** need less than 12 hours of light to initiate flowering. E.g. corn, soybean
- **Day neutral vegetables:** not affected by day length. E.g. tomato

Winds and temperature extremes:

- Dry, windy days and cool night temperatures (a 10°F drop from day temperatures) can cause fruiting crops to drop their flowers before they're pollinated
- Putting up some type of windbreaks to protect the crops from drying winds helps.
- Cold and hot frames can be used for extending the gardening season
- **Cold frames:** a glass enclosed growing area outside which uses solar heat; often called as the "poor man's greenhouse".
- Cold frames help extend the harvest of cool season vegetables like lettuce, pea
- Best position: sunny, south-facing location
- **Hot frames:** heat is provided either by rotting manure (the classic system) or by electricity (the modern way).
- Front of the bed to be full south

**Planning the garden: cropping systems****Selecting vegetables for a home garden:**

- Vegetables should be the ones preferred and likely to be eaten
- Variety of vegetables with nutritional diversity
- Easy to manage
- Highly productive and tolerant to common pests and diseases

Classifying vegetables:

- Botanical Classification
- According to plant part used
- Seasonal classification
- Based on use and botany combined
- Based on soil reaction
- Based on rooting depth
- Based on habitat
- Based on salt tolerance
- Based on life cycle

Most common: on the basis of the growing seasons

Vegetable	Days to first harvest
Amaranth	30-40
Asparagus	2 yr
Basella	40-45
Beans, bush	55-75
Beans, pole	65-95
Beets	65-80
Broccoli	65-100
Chenopodium	35-45
Cabbage (early)	60-90
Cabbage (late)	110-130
Carrots	60-90
Cauliflower	50-75
Corn	70-140
Cowpea	55-70
Cucumbers	60-75
Eggplant	80-100
Kangkong	30-35

Vegetable	Days to first harvest
Lettuce (leaf)	55-60
Muskmelon	90-115
Mustard (leaf)	35-40
Onions (green)	50-70
Onions (dry)	90-110
Peas	60-120
Peppers	90-110
Pumpkin	190-195
Radishes	25-40
Spinach	50-60
Squash (summer)	60-70
Squash (winter)	75-90
Tomatoes (staked)	65-110
Tomatoes (sprawl)	65-110
Turnips	60-70
Yard long bean	50-60

**Post-harvest care**

- Vegetables can be stored after harvesting to prolong their life
- They must be kept at the correct temperature and humidity
- Proper ventilation and sanitation must be maintained during storage
- Respiration during storage – should be kept minimum
- Water loss during storage – should be prevented
- Beet greens, green onions, lettuce, mustard greens, spinach, cabbage, turnip greens, asparagus, broccoli, brussel sprouts, carrots, cauliflower, celery, lima beans, peas, radish, sweet corn: 32-41 degrees F and 85-95% relative humidity (RH).
- Bell peppers, hot peppers, cucumbers, ripe melons, snap beans, summer squash (yellow, zucchini, scallop): 45 to 55 degrees F and 85-95% RH
- Eggplant, okra, ripe tomatoes, sweet potatoes: 50 to 60 degrees F
- Dry garlic, melons, dry onions (in open mesh container), tomatoes (mature green, partly ripe and ripe): at room temperature (65 to 70 degrees F) and away from direct sunlight.
- Drying and cold storage are easy and inexpensive ways to preserve and for storing vegetables.
- Don't wash vegetables before putting into cold storage.
- Cut tops off root vegetables.
- Check vegetables in cold storage frequently and remove any that are spoiled.
- Choose the location and preservation method for storing vegetables based on the vegetable's preferred temperature and humidity



- Cultural practices that ensure healthy plants growth
 - selection of the varieties/vegetables that are adapted to the conditions
 - physical destruction
 - inter culture to expose soil-inhabiting grubs and pupae
 - turning plant residues under in the fall
 - staking and mulching
- Crop rotation: for controlling soil borne diseases, soil insects, nematodes
 - avoid planting the same crops in the same area
 - avoid same family crops
 - change tall crops with small crops
 - change non-leguminous crops with leguminous crops
- Avoid using pesticides as much as possible
- Releasing predators can be beneficial in establishing them in new areas
- If using pesticides, use the ones with lower toxicity on certain crops
- Native beneficial insects can be attracted to home gardens by growing companion crops like dill, parsley, marigold, candytuft, salvia, lemon balm, thyme, and other herbs
- Pesticide handling:
 - Select the right pesticide for the treatment
 - Apply the pesticide following label directions
 - Protective clothing and equipment
 - Safely mixing pesticides and mixing area
 - Observe 'days to harvest'
 - Properly store and dispose the pesticide containers

Harvesting from a home garden

- Reasons of growing vegetables in home garden is to enjoy the safest good quality vegetable possible by fresh harvesting.
- Harvesting: depends on taste and timeliness
- **Fruit vegetables:** immature and mature
- **Leaf and stem vegetables:** slightly immature is preferable
- **Floral vegetables:** Hand harvest when head size is right
- **Roots, tubers and bulb vegetables:** various stages of development
- **Beans/pods:** Tender
- Harvest using clean, grade containers
- Dispose damaged fruit
- Properly wash all fruits and vegetables prior to eating



- Two broadest categories of plants based on temperature: **warm season** and **cool season crops**.

- **Warm/summer vegetables:** cannot withstand cold temperatures; adapted to 18-30C, intolerant to frost.

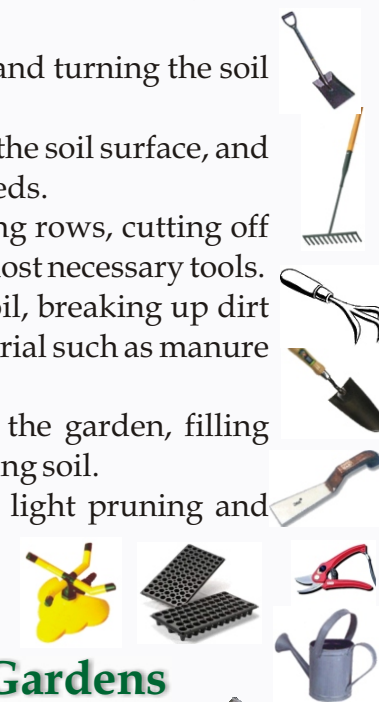
- **Cold/winter vegetables:** have optimum growth under cool temperatures; prefer 15-18C, are shallow rooted and small-sized.

Vegetables and their seasons			
Summer	Winter		Round the year
Ash gourd	Beet	Kohlrabi	Colocasia
Bitter gourd	Broccoli	Mustard	Cowpea
Jute	Carrot	Onion	Eggplant
Kakrol	Cabbage	Pea	Amaranth (green and red)
Pointed gourd	Chinese cabbage	Radish	Spinach
Ridge gourd	French bean	Spinach	Okra
Snake gourd	Turnip	Sword bean	Hot pepper
		Tomato	Sweet potato

Tools required

Only a handful of tools are required for a household level home garden. These include:

- A shovel or spade for digging, lifting, moving and turning the soil around
- A rake for leveling and grading soil, stirring up the soil surface, and removing lumps, rocks, and shallow-rooted weeds.
- A hoe for stirring or mounding the soil, making rows, cutting off weeds and cultivating. - one of the gardener's most necessary tools.
- A spading fork for turning and aerating the soil, breaking up dirt clods, lifting root crops and moving heavy material such as manure and garden compost.
- A trowel for transplanting young plants into the garden, filling containers, dividing clumps of plants, and leveling soil.
- Secateurs for taking cuttings for propagation, light pruning and cutting.
- Seed trays for raising cuttings or growing seeds
- Water cans and sprinklers for watering

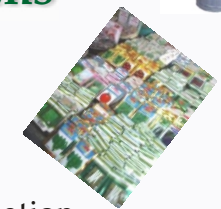


Package of Practices for Home Gardens

- **Variety selection:**
 - Reliable and adapted
 - Productive with desirable quality
 - Resistant to major diseases, insect-pests
 - Open pollinated or hybrids
- **Good healthy seeds**
 - Seed could also be a cutting, rhizome, bulb or tuber
 - Free from damage, mixtures, infection

and contamination

- With good vigor and germination capacity
- Purchased from reliable source; Certified seeds



- **Land preparation:** for a newly established garden-
 - Soil should be sterilized to eliminate weeds and soil-borne pathogenic microorganisms
 - Deep plowing for loosening of a thick layer of soil, improves internal drainage
 - Harrowing for breaking up large soil clods
 - Add the compost or well decomposed FYM
 - Make the proper tilth of soil and level it
 - Raised beds (~20cm) preferred for growing vegetables



- **Seed sowing methods:**

- **Line sowing:** provide proper row to row and plant to plant spacing
- **Broad casting:** seedlings are not evenly distributed- some of them are too crowded
- **Drilling:** Drill sowing with uniform spacing: can also be mechanized
- **Sowing at high density (nursery):** Prick out the extra newly emerged seedlings; helps multi-picking

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Crops transplanted

Cabbage	Pepper
Chinese cabbage	Bitter gourd
Broccoli	Onion
Cauliflower	Celery
Tomato	Lettuce
Eggplant	Watermelon
Cucumber	Squash

Crops direct seeded

Cowpea	Kangkong
Soybean	Yardlong bean
Garden pea	Watermelon
Pak-choi	Squash
Lettuce	Cucumber
Snap bean	Bitter gourd

Crops that should be direct seeded

Amaranthus	Coriander
Radish	Turnips
Cowpea	Garden pea
Soybean	Beets
Fenugreek	Spinach
Pea	Okra
Carrot	Beans

- **Companion planting:**

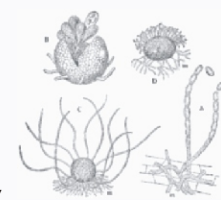
Some plants secrete growth-suppressing chemicals:

- Beans do not follow onions well
- Tomato/potato do not follow Brassicas well
- Gourds do not follow onion, garlic well

- Pruning should be done with a sharp blade to minimize damage to the plant tissues and to facilitate recovery.
- **Uses of pruning:** increases fruit size and causes earlier maturity
improves air circulation within the canopy
reduces foliar diseases
facilitates spraying and harvesting
reduces too much vegetative growth
- In indeterminate tomatoes: pruning results in single-stem plants which can easily be tied to the stake.
- In the case of cucurbits, pruning of the tip of the seedling stimulates early branching and fruiting on lower nodes.
- Pruning of mature plants that have declined in productivity: main stem is cut 20 cm from the ground and stimulated to produce new branches by applying fertilizer and irrigation.
- **Sanitation for home gardens:**
- Remove the old infected, un-fruiting plants
- Destroy the disease or insect infected plant parts away from the HG
- Inter-culture the soil for removing the weeds, making good soil tilth and proper aeration
- Remove the un-fruiting old branches –especially in chilli, eggplant
- Remove food and water sources away from HG to protect from insect-pests

IPM for Home Gardens

- Incidence and occurrence of insect-pests depends on the environment and microclimate of a particular location.
- In order to achieve eco-friendly and sustainable insect and pest management, the inputs of both production as well as protection technologies are to be applied appropriately:
- Crop production:
 - sanitation/ clean cultivation, weed free crop,
 - summer ploughing, fallowing, flooding,
 - crop rotation, integrated nutrient management,
 - resistant/ tolerant varieties,
 - cultural practices like mulching, drip irrigation etc.
- Crop protection:
 - removal of crop plant residues/ debris,
 - use of biocontrol agents, traps, botanicals
 - need based pesticides.



• **Fertilizer management:**

- Fertilizers may be Inorganic or organic
- Inorganic fertilizers: Urea, Triple Super Phosphate, Murate of Potash
- **Fertilizing:** Leafy vegetables need more nitrogen (N), flower and fruit vegetables need more phosphorus (P) and root vegetables need more potassium (K).
- Grades of complete fertilizer (NPK): 14-14-14, 12-24-12, and 5-10-16.
- Organic fertilizers: Dung fertilizer, FYM, compost, green manure, vermicompost
- Use only fully decomposed organic matter
- Fertilizers must be mixed in the soil before sowing
- If necessary, apply fertilizers as side dressing, drench or as foliar sprays
- Critical time for different vegetables when fertilizer application is a must:

Crop	Fertilizer
Beans	After heavy blossom and set of pods
Cabbage, cauliflower, broccoli	3 weeks after transplanting
Cucumber, Melons	1 week after blossoming begins and same amount 3 weeks later
Onion, garlic	1 to 2 weeks after bulb formation starts
Potato, radish, turnip, carrot	After tuber formation starts (blooming stage), about 6 weeks after planting
Tomato, pepper, eggplant	1 to 2 weeks before first picking and same amount 2 weeks after first picking

• **Mulching, pruning and staking:**

- Types: organic (straw, grass clippings, leaves, compost and rotted sawdust) or plastic
- Begin mulching about 1 month after planting; Keep away from plant stems
- **Uses of mulching:** Conserves & maintains soil moisture



- Reduces erosion and controls weeds
- Increases organic matter content of soil
- Reduces nutrient leaching
- Maintain soil temperatures and moderates them
- Keeps vegetables cleaner & decreases soil splash

• **Uses of staking:** Optimum use of spacing



- Facilitates management operations: irrigation inter-tillage, pest control, and harvesting
- Lessens contact of fruit with soil
- Helps produce better products



• **Healthy nursery raising:**

Three most common and beneficial methods:

1. **Seed bed method**
2. **Plug and flat tray method**
3. **Seedling container method**

Seed Treatment: for disease and insect pest control

Chemical treatments: Captan/Thiram @ 2-3g/kg
for seeds Bavistin @ 1-2g/kg

Imidaclopride @ 1ml/kg
Bio-control agent 2-5g/kg



Soil solarization

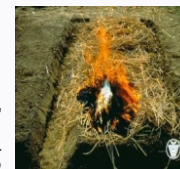
Heat/burning: using straw, done during the summer months (May and June) for 8-9 weeks after incorporation of compost and fertilizers followed by covering with a transparent plastic sheet (100-300 µm thick).

Chemical solarization: Formalin treatment

- 40% formalin solution diluted with 5-6 times water

- Dosage: 500 ml formalin per square meter

- cover with plastic sheets for 24-48 hrs and then leave the bed exposed for 4-5 days



Seed Bed Method

- Soil selection: Open sunny place, friable, free from crust formation, disease organisms or a previous history of the diseases incidence, well drained with good tilth, fertile with continuous supply of nutrients, proper moisture and pH 6.5 to 7.0.
- Prepare desirable seed beds, mix compost (2 kg/msq.) and N:P:K (10:10:10 g/msq.).
- Solarize the soil
- Level the bed again, sow the seeds separately evenly in 0.5 to 1 cm deep furrows.
- Furrows: 6 cm apart for tomato, pepper and onion
8-10 cm apart for cabbage, cauliflower, eggplant
- Cover the seeds with the nursery soil and rice straw
- Irrigation (fine sprinkler or spraying): daily during the hot and dry season and alternate days in the cool season.
- Cover the beds with nylon screen
- Thin out the excess seedlings which can be transplanted in the home garden



Plug or flat tray method

- Well designed flats are light and sturdy
- 10- to 12 cm deep plastic or wooden flat's tray can be used
- Plug trays with 50/72 or 90/128 number of holes with size 4-cm deep and 4.6-cm diameter are mostly used for nursery raising

- Potting media:**

Soil, compost, sand and smoked rice hulls (5:3:1:1)

Coco-peat: vermiculite: perlite (3:1:1)

Compost/potting mixture: soil: sand (3:1:1)

Compost, rice hull/husk and sand (3:1:1)

- Sterilize media either by heat or chemical
- Cover the nursery with net cover and

**Seedling container method**

- Materials used: Plastic bags, biodegradable bags
- Perforated plastic bags 5-7 cm wide and 10 cm long
- Maintenance includes thinning, regular irrigation and cover under net



- Starter solution:**

- NPK mixtures in the ratio of 20:20:20; 15:15:15; 18:18:18 etc available
- Start using from second week of seed sowing
- Apply two times at one week interval before transplanting
- **Dosage: SST 5 ml per seedlings in the evening time**
- Use of starter solution provides the optimum NPK for the better and early growth of the seedlings

- Seedling transplantation:**

For tomato, pepper, eggplant: 3-6 open true leaves, stem height of 10-15 cm
For cabbage, chinese cabbage, cauliflower, kohlrabi, lettuce: 4-5 true leaves, 3-5 weeks.

- Moisten the nursery beds or seedling flats/pots 1-2hrs before transplanting.
- Harden seedlings by stopping irrigation 3-4 days before transplanting to minimize seedling mortality in the home garden

- Soil management:**

- Soil should be- **Clay loam** or **sandy loam** for high yield (equal amount of sand, silt, and clay)
- Well drained
- Fertile with continuous supply of nutrients
- Good moisture retention capacity
- The ideal soil pH for most of the vegetables is 6.5 to 7.0.
- Crop selection according to the soil pH:

pH	Crops tolerance
6.0-6.8 (slight)	Cabbage, cauliflower, beet root, lettuce, muskmelon, okra, onion, celery, spinach and cowpea
5.5-6.8 (moderate)	Beans, brinjal, carrot, cucumber, garlic, pepper, peas, radish, tomato, pumpkin, turnip, knolkhol
5.0-6.8 (high)	Potato, sweet potato and watermelon

Saline tolerant crops	
Less	Celery, peas beans, radish, Potato, sweet potato, snake gourd, brinjal, sweet pepper
Moderate	Tomato, chilli, water melon, cucumber, muskmelon, bottle gourd, Cabbage, cauliflower, carrot, onion, amaranth
Tolerant	Beet root, spinach, turnip, kale, lettuce, bitter gourd, asparagus, ash gourd

- Water management:**

- Careful watering should be done until the seedlings have emerged, especially when the seeds are small
- Place water at the root zone
- Ridges help keep water away from plants and lead it directly to the roots
- Insufficient water at any growth stage reduces yield and fruit quality
- Watering should be done preferably in the morning
- Critical time for different vegetables when irrigation is a must:

Crop	Water need
Beans	Bloom, pollination and pod enlargement
Cabbage, cauliflower, broccoli	Establishment, head development
Cucumber	Flowering and fruit development
Melons	Fruit set and early development
Onion, garlic	Bulb enlargement
Potato, radish, turnip, carrot	Tuber set and tuber enlargement
Tomato, pepper, eggplant	Uniform supply from flowering through harvesting



- If affordable, small drip irrigation system can be installed for a home garden
- Application of water to the soil through small emitters which are installed close to the plant, wetting only these areas leaving the rest of the garden dry.
- Drip irrigation not only saves labor and fertilizers but also increases water use efficiency, and reduces soil-borne diseases.