

2017

Home Gardening-the Way Forward



Art of developing
sound home garden
models

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Planning a vegetable garden

- ▶ Use common vegetable growing seasons
- ▶ Do not expect miracles
 - ▶ Every good thing takes a little work.
 - ▶ Don't hesitate to ask the experts or search online for information.

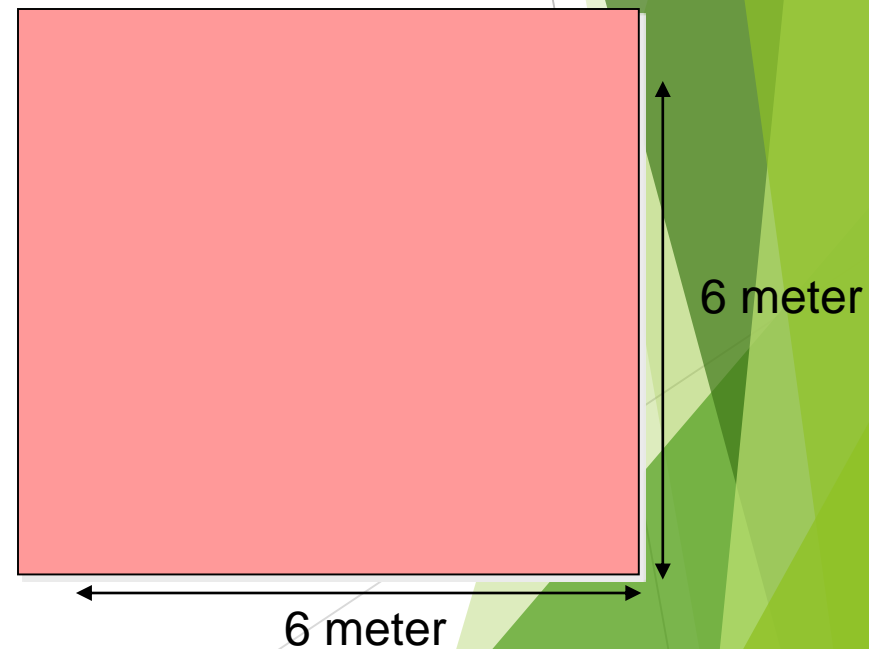
Know before you plant

- Location
- Soil types
- Fencing
- Garden layout
- Types of crops
- Sowing time
- Rotation of crops
- Layout blue-print
- Planting methods & requirement
- Anticipated pests and their control.



Selection of plot area

- ▶ Size
- ▶ Depends upon the family members
- ▶ For a 4-5 member family
 - ▶ Start small (6 x 6' or more)
 - ▶ 10-15 vegetable in each seasons
 - ▶ Most seed packs plant a 15 row per plot





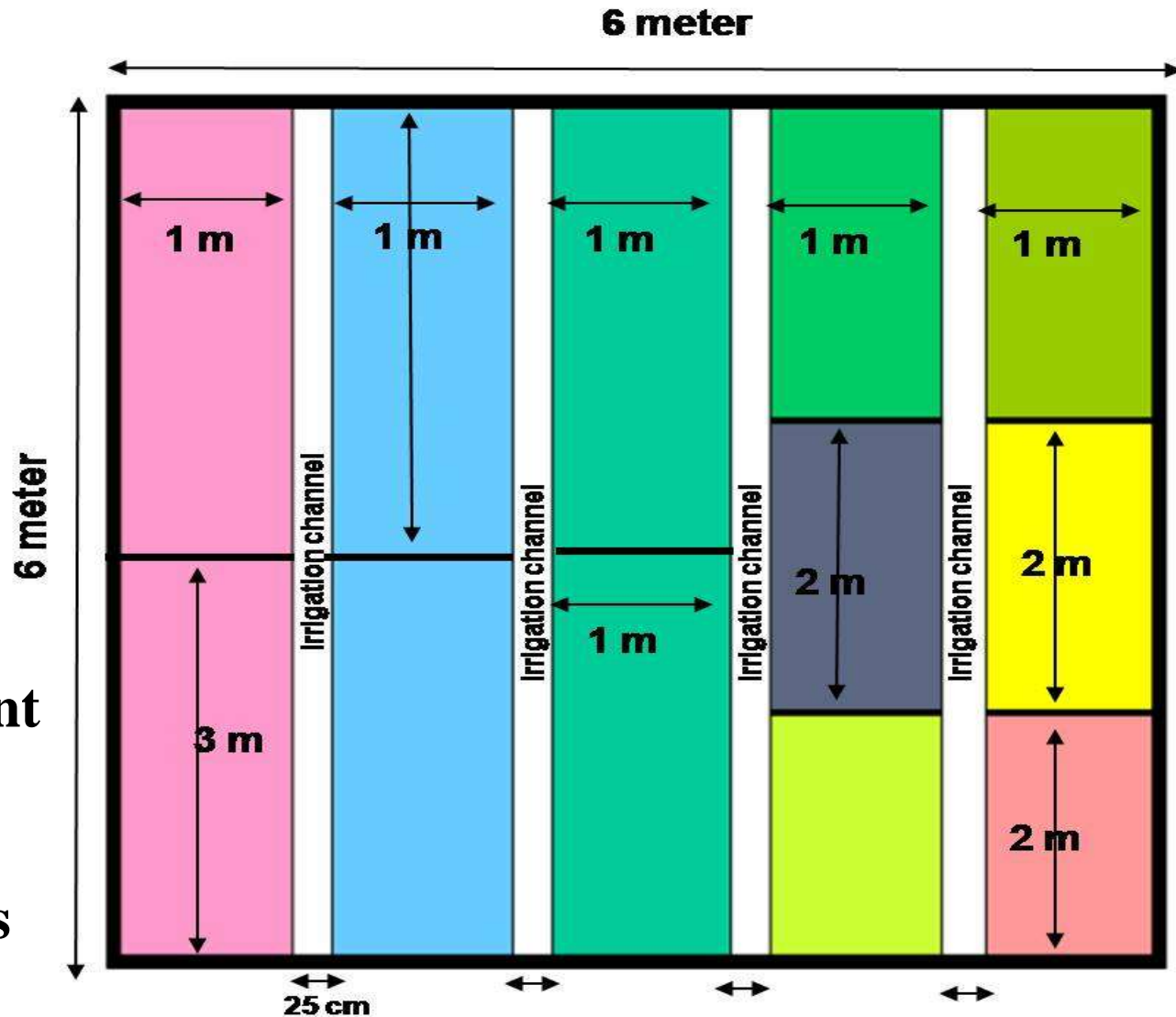
Discuss and make a rough layout/ map of the proposed home garden

Garden layout

5 blocks
12 sub-plots
Size:
3 x 1 m
2 x 1 m

Making a sowing Plan

- Varieties grown
- Crop arrangement
- Time in garden
- Time of planting
- Cropping seasons



Land preparations

- ▶ Soil should be friable, free from crust formation, disease organisms
- ▶ Raised bed are preferred
 - ▶ 20 cm height
- ▶ Rows should be with proper crop planting distance



Seasons

Summer	Rainy	Winter	Round the year
Ash gourd	Capsicum	Beet	Tomato
Bitter gourd	Brinjal	Broccoli	Colocasia
Jute	Chilli	Carrot	Cowpea
Kakrol	Cluster bean	Cabbage	Eggplant
Pointed gourd	Beans	Chinese cabbage	Amaranth
Ridge gourd	Okra	French bean	Spinach
Snake gourd	Amaranth	Turnip	Okra
Sponge gourd	Bitter gourd	Kohlrabi	Hot pepper
Tomato	Bottle gourd	Mustard	Sweet potato
Amaranthus	Cauliflower	Onion	Kangkong
Bitter gourd	Cowpea	Pea	Basella
Cluster bean	Cucumber	Radish	
Cucumber	Tomato	Spinach	
French bean	Round gourd	Sword bean	
Okra		Tomato	

Sowing methods

Classified into three categories

- Transplanted crops
- Direct-seeded crops
- Should be direct-seeded

► Usually transplanted

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

• Usually direct-seeded

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

Sowing methods

► 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 do not grow well with other plants
- ▶ Some plants do better next to certain types of plants
- ▶ **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**
- ▶ **Some plants have insect repellent properties**
 - ▶ **Onion, garlic, marigold, ocimum**
 - ▶ **corn/squash canopy disorients squash vine borer**
- ▶ **Some plants attract beneficial insects**
 - ▶ **Mustard, lily, marigold**

Crop sowing and harvesting time: Location specific

Crops	Sowing time	Transplanting time	Harvest period
Amaranthus	Feb.-July	-	April-Oct.
Basella	Feb-Nov	-	Round the year
Beat Root	Oct.-Nov.	-	Dec.-Feb.
Bitter Gourd	Feb.-March June-July	-	May-July Aug.-Oct.
Bottle Gourd	Feb.-March June-July	-	April-June Oct.-Dec.
Brinjal	Jan.-Feb. May-June Oct.-Nov.	Feb-Mar. June-July Jan.	April-June Sept.-Nov. March-May
Cabbage	Sept.-Oct.	Oct.-Nov.	Dec.-March
Capsicum	Nov.-Jan. June-July	Jan.-Feb. July-aug.	April-May Sept.-Oct.
Carrot	Aug-Oct.	-	Dec.-March
Cauliflower	Early June July-Sept. Sept.-Oct.	July Aug.-Oct. Oct.-Nov.	Nov. Nov.-Jan. Jan.-March
Chillies	Nov.-Jan. May-June	Jan.-March June-July	April-June Sept.-Nov.

Crop sowing and harvesting time: Location specific

Crops	Sowing time	Transplanting time	Harvest period
Cluster Bean	Feb.-March June-July	-	April-June Aug.-Oct.
Cowpea	June-July Feb.-March	-	Aug-Oct. April-June
Cucumber	Feb.-March June-July	-	May-July Aug-Oct.
Dolichos Bean	June-July	-	Oct.-Dec.
Fenu greek	Sept.-Nov.	-	Nov.-Feb.
French Bean	Feb. - March	-	April-May
Kangkong	Feb-Oct	-	Round the year
Lettuce	Sept.-Oct.	Oct.-Nov.	Dec.-Feb.
Mustard	Sept.-Nov. Feb-March	-	Nov.-Feb. March-May
Okra	Feb.-March June-July	-	March-June Aug.-Nov.
Onion	Oct.-Nov. May-June	Dec.-Jan. June-July	April-June Oct.-Nov.
Garden peas	Sept.-Oct. Oct.-Nov	- -	Nov.-Jan. Jan.-March

Crop sowing and harvesting time: Location specific

Crops	Sowing time	Transplanting time	Harvest period
Radish	April-Aug. Sept-Oct. Nov.-Jan	-	May-Sept Nov.-Jan. Dec.-March
Palak	Sept.-Nov. Feb.	-	Nov.-Feb. March-April
Sponge Gourd	Feb.-March	-	April-June
Sweet potato	April-August	-	June-September
Vegetable Soybean	June-August	-	July-Sept
Ridge Gourd	June-July	-	Aug.-Oct.
Round melon	Feb.-March June-July	-	May-June Sept-Oct.
Tomato	June-Aug. Nov.-Dec.	Aug.-Sept. Dec.-Feb	Oct.-Dec. April-June.
Turnip	Oct.-Nov.	-	Dec.-March.
Yard long bean	Feb-Oct	-	April-March

Crop selection: North India module

Crop (Plot size m)	Period	
French Bean (3x1)	January	April
Onion (3x1)	January	May
Capsicum (2x1)	February	Jun
Long Melon (2x1)	March	June
Cucumber (2x1)	March	June
Kangkong (2x1)	March	November
Basella (2x1)	March	October
Chilli (3x1)	March	October
Cowpea (2x1)	March/July	June/October
Okra (2x1)	March/July	June/October
Lettuce (2x1)	May	June
Radish (2x1; 3x1)	May/July	June/September

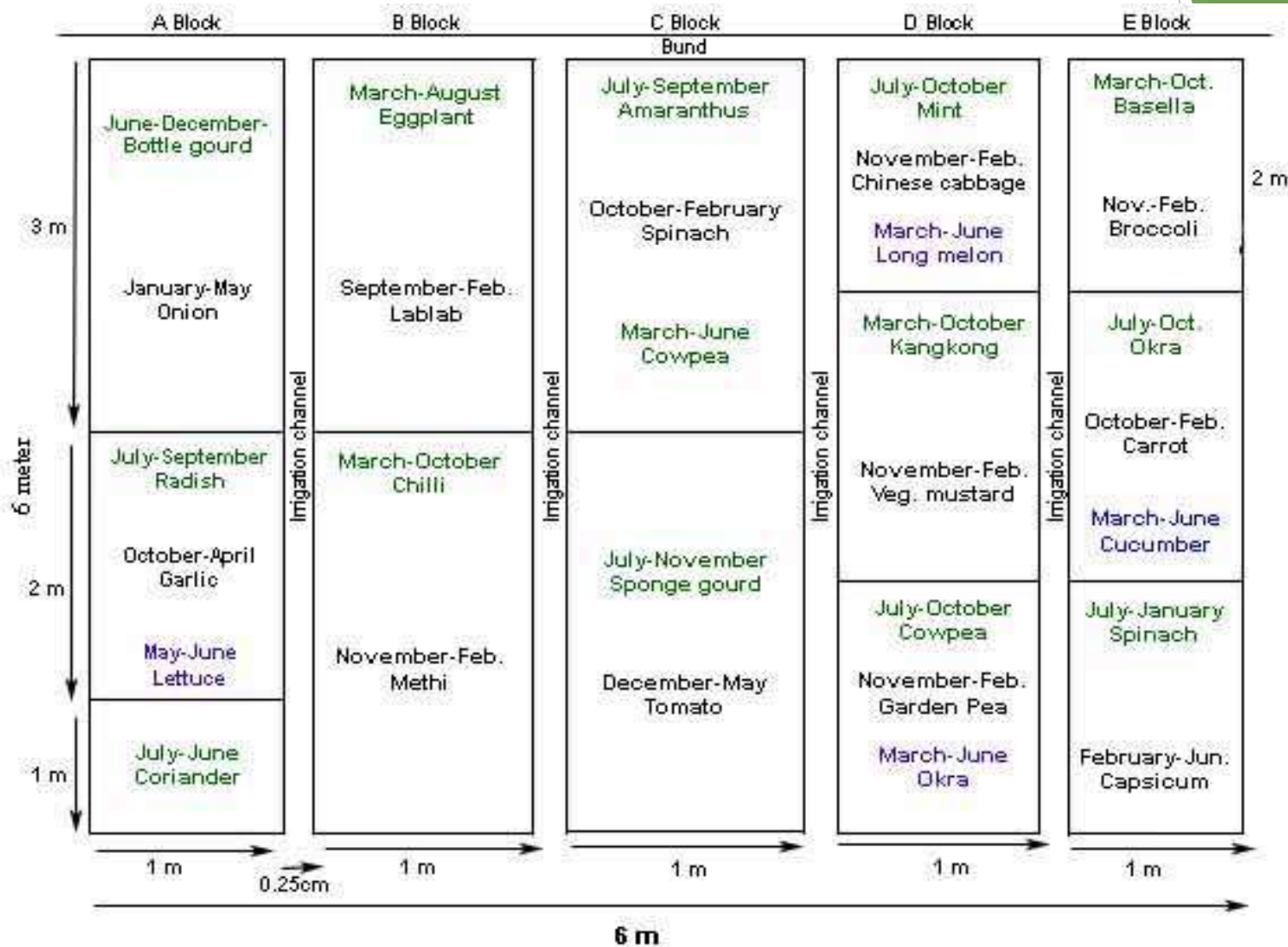
Crop selection: North India module

Crop (Plot size m)	Period	
Bottle gourd (3x1)	June	December
Sponge gourd (3x1)	June	November
Brinjal (3x1)	July	December
Coriander (1x1)	July	July
Amaranthus (3x1)	July	October
Mint (2x1)	July	October
Spinach (2x1)	July/November	January/ February
Garlic (2x1)	October	April
Carrot (2x1)	October	February
Broccoli (2x1)	November	February
Chinese cabbage (2x1)	November	February
Garden pea (2x1)	November	February
Lablab (2 x 1)	November	February
Methi (3x1)	November	February
Tomato (3x1)	December	May

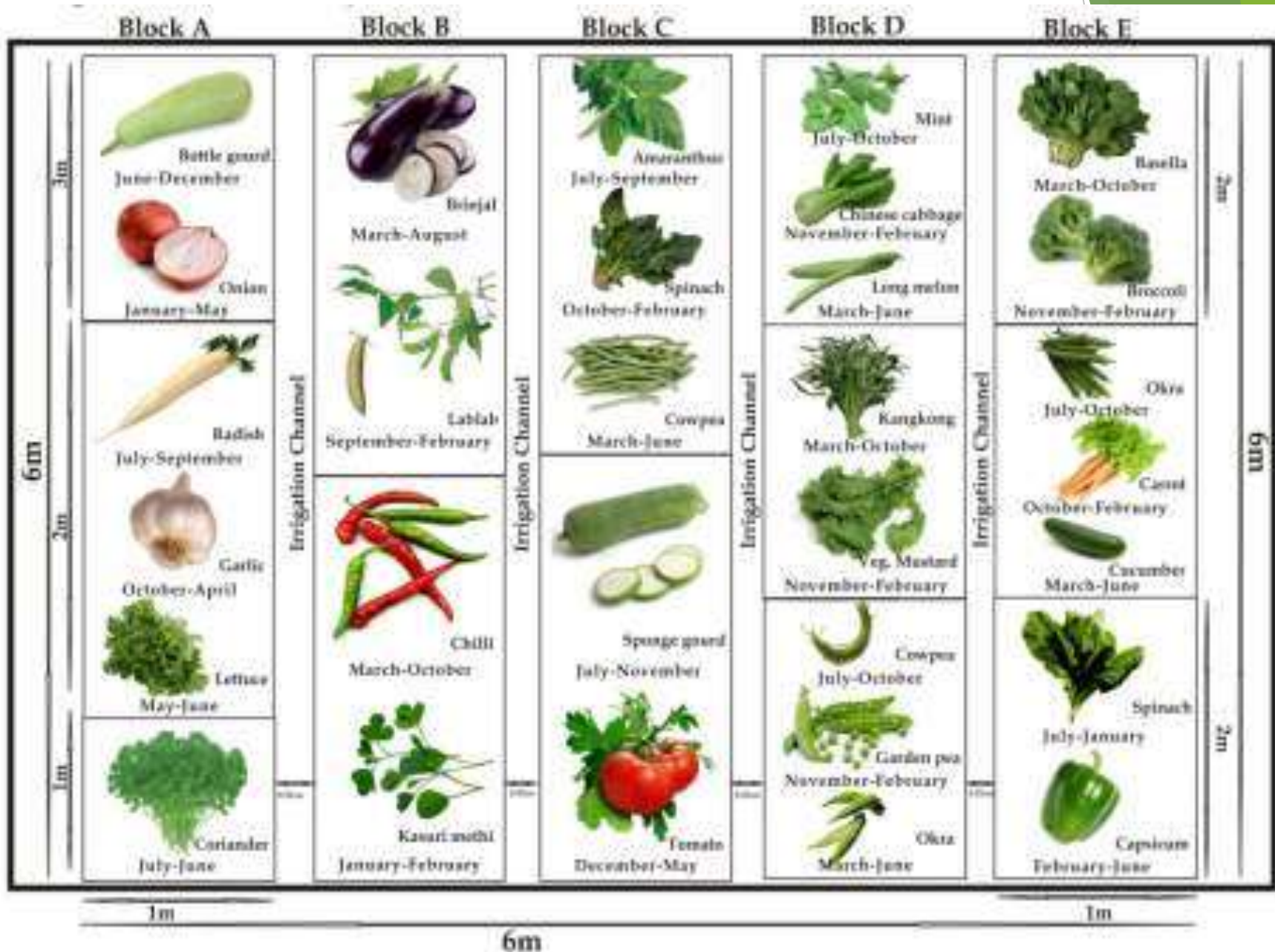
Crop selection: North India module

Plot no.	First crop (Date)	Follow-up crop (Date)	Follow-up crop (Date)
1	Bottle gourd (June-Dec.)	Onion (Jan- May.)	
2	Radish (July- Sept.)	Garlic (Oct-April)	Lettuce (May-June)
3	Coriander (July- June)	-	-
4	Eggplant (July-Dec.)	French Bean (Jan.- April)	Radish (May-June)
5	Chilli (March-Oct.)	Methi (Nov.-Feb:)	-
6	Amaranthus (July-Sep.)	Spinach (Oct.-Feb.)	Cowpea (March.-June.)
7	Sponge gourd (July-Nov.)	Tomato (Dec.-May)	-
8	Mint (July-Oct.)	Chinese cabbage (Nov.-Feb.)	Long melon (March-June)
9	Kangkong (March.-Nov)	Lablab (Nov. Feb)	-
10	Cowpea (July-Oct)	Garden pea (Nov-Feb)	Okra (March-June)
11	Basella (March-Oct.)	Broccoli (Nov. Feb.)	-
12	Okra (July-Oct.)	Carrot (Oct-Feb.)	Cucumber (March-June.)
13	Spinach (July-Jan.)	Capsicum (Feb-June.)	-

Garden blueprint: North India



Garden blueprint : North India developed by Dr. M. L.Chadha



Get a quality start!

▶ **Variety selection**

- ▶ reliable and adapted
- ▶ productive with desirable quality
- ▶ resistant to major diseases and insect-pests
- ▶ open pollinated or hybrids

▶ **Seed procurement**

- ▶ Seed may also be a cutting, rhizome, bulb or tuber
- ▶ Fresh seeds
- ▶ Free from infection, contamination,
- ▶ with good vigour and germination capacity
- ▶ Purchased from reliable source
- ▶ Certified seeds

Plant spacing and seed

Crop (Plot size m))	Sowing times	Spacing R x P cm	Plant /plot	Seed g
French Bean (3x1)	1	30 x 25	66	50
Onion (3x1)	1	15 x 10	217	2
Capsicum (2x1)	1	60 x 45	15	0.5
Long melon (2x1)	1	100 x 100	4	1
Cucumber (2x1)	1	100 x 75	6	1
Basella (2x1)	1	30 x 15	56	10
Chilli (3x1)	1	60 x 45	21	1
Lettuce (2x1)	1	15 x 10	126	0.5
Radish (2x1; 3x1)	2	20 x 10	155	10
Bottle gourd (3x1)	1	100 x 100	3	1
Sponge gourd (3x1)	1	100 x 100	6	8
Brinjal (3x1)	1	60 x 45	18	0.5
Carrot (2x1)	1	20 x 10	105	1

Plant spacing and seed

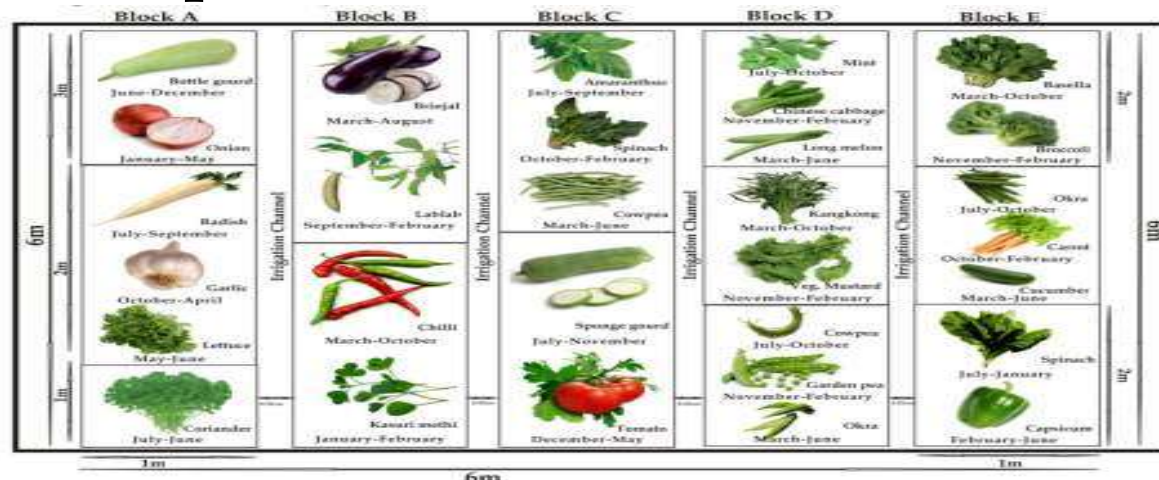
Crop (Plot size m))	Sowing times	Spacing R x P cm	Plant /plot	Seed g
Broccoli (2x1)	1	30 x 20	36	1
Chinese Cabbage (2x1)	1	30 x 20	36	1
Garden Pea (2x1)	1	25 x 15	56	50
Lablab (2 x 1)	1	30 x 15	42	50
Tomato (3x1)	1	60 x 45	18	1
Methi (3x1)	1	15 x 10	186	10
Amaranthus (3x1)	1	15 x 10	217	1
Mint (2x1)	1	15 x 15	91	100 cuttings
Garlic (2x1)	1	15 x 10	147	
Spinach (2x1)	2	15 x 5	366	30
Cowpea (2x1)	2	45 x 20	30	30
Okra (2x1)	2	33 x 30	21	20
Coriander (1x1)	Round the year (4)	30 x 10	55	20
Kang kong (2x1)	Round the year (3)	30 x 20	42	15

- **Home gardening** : “An area around the home where different vegetables and fruits are grown throughout the year to meet family nutritional requirements
- **Home gardens:**
 - produce vegetables free from toxic pesticides
 - Cultivation of diverse vegetables for year round availability
 - Production primarily for consumption
 - Use of low-cost inputs and indigenous varieties; reducing dependence on exotic or imported varieties
 - Management by members of household (wife, husband, children)



Home Gardening: Grow Your Own Food ?

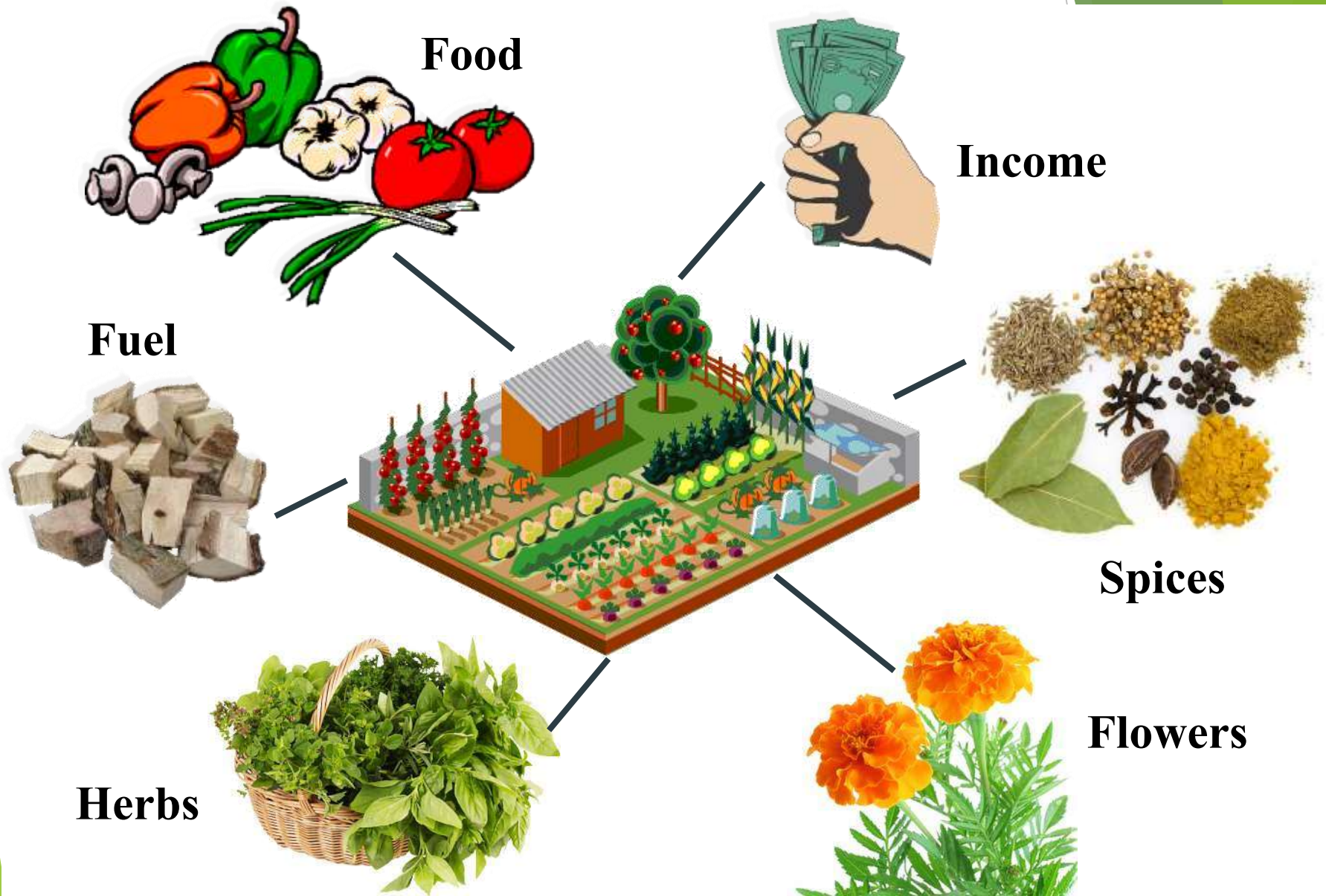
- Design based on growing Safe and Healthy vegetables rich in vitamin-A, protein, iron and iodine,
- to ensure year round supply of vegetables.
- Yield 250-300kg/year.
- Models met >100% of beta carotene and Vit. C requirements
- Met nearly 3/4th of protein and 1/4th - 1/5th of iron requirements



Yield @ 69.4t/ha against the average 12.7t/ha



Home gardens provide:



Home gardening: for great physical activity

- A great, low-impact exercise: Doctors suggest 30-60 minutes of low to moderate intensity physical activity per day for a healthy heart and weight.
- Typical calories burnt (in adults) for 30 minutes of:

Comparison of energy expenditure of gardening and wellness centre equipment

	Energy expenditure (kcal)
Total EP for a 6x6 m ² garden activities	53786
If we work in the garden	Energy expenditure (kcal/hour)
One hour per day for 2 months	896
Two hour per day for 2 months	448
One hour per day for 3 months	598
Two hour per day for 3 months	299
With wellness centre exercise equipment	
Treadmill (speed 1.5km/hr)	120
Treadmill (speed 3.0km/hr)	168
Treadmill (speed 6.0km/hr)	220
Elliptical trainer (speed 10.7 km/hr)	300
Recumbent bike (speed 12 km/hr)	240



Types and Designs of Home Gardens – they can vary

- **Between city and village:** Cities have limited land: in containers, roof, balconies; in villages land may not be a limiting factor but choice of seeds may be limited and thus there will be limited type's vegetables in the garden.
- **Between village:** traditions, eating habits, availability of resources like water and other inputs in and around different villages
- **Between individual families:** choices of different vegetables determine the designs and types of garden.
- **Family size also makes difference:** large size family need bigger garden than small size, hence design has to be different between the two.

Factors to consider in selection a garden site:

1. Sunlight
2. Nearness to the house
3. Water
4. Soil
5. Good air drainage
6. Shelter



Sunlight:

- At least 6 hours of direct sunlight each day; **8-10 hours is ideal.**
- Away from the shade of buildings, trees, and shrubs.
- **Best location:** a plot sloping a little to the **south or east** - catches sunshine early and holds it late.
- Some leafy vegetables such as spinach, mint, and lettuce tolerate shadier conditions than other vegetables.

Nearness to the house :

- Closer the home garden, easier and more frequent to use it.
- Harvest vegetables at their peaks and thus take maximum advantages of garden freshness.
- Weeding, watering, insect/disease control, and succession planting can be better managed if the garden is close by.

Water:

- Essential to locate the garden near a water source.
- Water as per the need of the crop; avoid over and under watering



Soil: fertile and easy to till-- a **rich, sandy, light, loam**

- "**Rich**": full of plant food - by cultivation and manuring.
- "**Sandy**": soil containing enough particles of sand for proper drainage;
- "**Light**": a handful, under ordinary conditions, will crumble and fall apart readily after being pressed in the hand.
- "**Loam**": sand and clay are in proper proportions

**** Points to remember:**

- Avoid any soil that remains soggy after a rain.
- Heavy clay and sandy soils can be improved by adding organic matter.



Good air drainage:

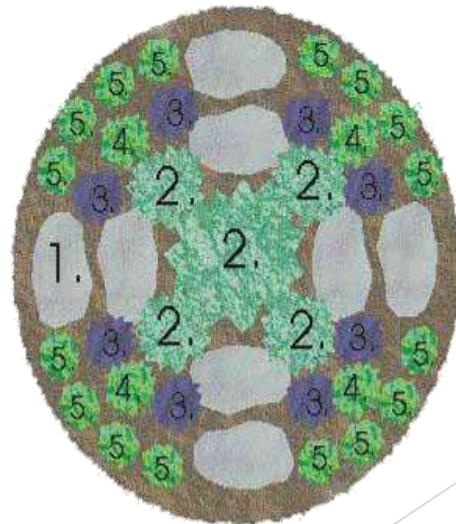
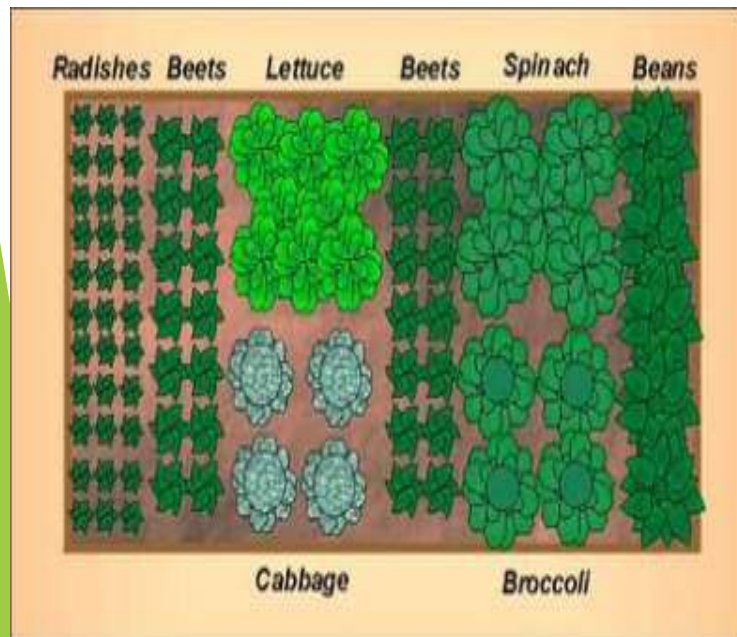
- Avoid locating the garden in a waterlogged area such as the foot of a slope.

Shelter:

- Vegetable crops severely affected in windy sites: reducing yields by 25%.
- **windbreaks** help to baffle and filter the wind.

Shape of the garden plot

- **Square or Rectangular:** more convenient to work and more easy to keep neat and clean.
- At least open on two ends
- Practice **crop rotation** to some extent within the limits of even the small vegetable garden, but much better, if possible, to rotate the entire garden-patch.



Climate and home gardening

★ "Growing Season"

- Length of time an area can give plants the conditions they need to reach maturity and produce a crop.
- Length totally dependent on the local climate.
- The way a vegetable type reacts to climatic conditions — heat, cold, moisture, and so on — determines its "hardiness".
- The vegetables grown in a home garden fall into one of four hardiness categories: *very hardy*, *hardy*, *tender*, and *very tender*.



★ “Temperatures”

- Temperatures, both high and low, affect growth, flowering, pollination, and the development of fruits.
- If the temperature is too high or too low, leafy crops forced to flower prematurely without producing the desired edible foliage – condition called as “going to seed,”. e.g. cabbages and lettuce.
- If the night temperatures get too cool it may cause fruiting crops to drop their flowers – reducing yields. E.g. hot and sweet peppers
- Ideal temperature: between **4° and 30°C**.
- On this basis: classified as cool-season or warm-season crops.

★ “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. e.g. in tomatoes, peppers, beans, eggplant, melons, pumpkins, squash.
- **Too little rain:** can slow down plant growth and kill young seedlings or even mature plants.
- Limited moisture in the air can also inhibit pollination and reduce the yields of some vegetables.

★ “Day Length”

- Some vegetables not affected by day length. E.g. tomatoes.
- **Long-day plants** (need 12 or more hours of sunlight daily in order to initiate flowering). Include radish, onion, spinach.
- **Short-day plants** (need less than 12 hours of light to initiate flowering). Include soybean, corn
- Day length neutral vegetables don't respond to short or long days. e.g. lima beans

Types of home gardens

- Home/nutritive/kitchen gardens
- Hanging/vertical gardens
- Container/terrace gardens
- Roof gardens

Home Gardens can be:

➤ Fixed

- land is compact; can be divided into different sections and beds prepared as necessary.

➤ Scattered

- consists of plots in different areas.
- Various small areas of land around the home used to grow different varieties of vegetables constitutes a scattered garden.
- More familiar than fixed gardens to the landless and marginal population.



Hanging/vertical gardens

- ❖ The idea of taking vegetables that in their natural state may tend to sprawl over the ground, and providing a support structure to allow them to grow vertically.
- ❖ Advantages:
 - ❖ Can make use of unusable space for the garden.
 - ❖ Areas like rooftops or patios can add to the garden with this approach.
 - ❖ Growing vegetables upright makes them easier to harvest.
 - ❖ A vertically trained plant can be used to improve the esthetics of the yard, hiding things like utility transformers or boxes with a trellis or small fence, or simply to dress up a boring wall



Choice of vegetables

- ❖ Vegetables that can do well in a vertical setting include climbing plants like beans, peas.
- ❖ Tomatoes are often staked to do well, with indeterminate varieties like cherry tomatoes often a favorite.
- ❖ Non traditional choices for vertical gardening are vining plants, such as melons, squash, cucumbers and pumpkins.



Support structures

- ❖ **Simple stakes or poles:** Often used for peas and beans.
- ❖ **Simple trellis:** A common choice for cucumbers
- ❖ **Fence**
- ❖ **Support cage made from wood or PVC pipe:** Combined with netting to support larger fruits like melons, this is a good choice for melons or pumpkins.
- ❖ **When placing a trellis or stake, be aware of your seasonal wind patterns and adequate strength to support mature plants**



Steps for setting up the garden

- ❖ Pick the vegetables you wish to use.
- ❖ **Corn** can be positioned against gardening poles.
- ❖ **Pumpkins** can be used at the base for good mulching ground coverage.
- ❖ **Pole beans** can even climb up the poles that the corn stalks are positioned against or simply up the corn stalks.
- ❖ **Winter squash** can be grown indoors in little peat pots
- ❖ **Vining cucumbers** can be grown up the trellis using thick garden string to hold the vines to the boards.
- ❖ Garden cages are also good for this.



Cont.....

- ❖ Snow peas can be grown up the trellis, garden cage or netting.
- ❖ **Sturdy wire, metal or wood can support to grow any type of tomato vertically.**
- ❖ Hanging baskets can be placed on the balcony or on suitable hangers.
- ❖ **Water the vertical garden frequently as the plants will be up in the air, they will dry out more quickly.**
- ❖ **A stepladder** can be used as a makeshift trellis to support vine-growing plants like pumpkins, squash, and cucumbers.
- ❖ **The rungs of the ladder can be used to train the vines while placing the vegetables on its steps for further support.**



❖ **Vertical vegetable garden:**
perfect way for urban gardeners and others to still enjoy a bountiful harvest of freshly grown vegetables without taking up their already limited space.





Container Gardens

- ❖ Lack of space for people living in an apartment, condominium; therefore do not grow a vegetable garden
- ❖ Containers can be placed on sidewalks, patios, window boxes, porches or balconies
- ❖ Container gardening helps to:
 - Save space
 - Garden indoors or on a patio
 - Create an area for peace and tranquility
 - Enhance the diet with fresh vegetables and herbs
 - Move the vegetables if they need more/less sunlight
 - Water more efficiently by increasing or decreasing drainage



Main considerations

- ❖ Choosing a proper container
- ❖ Using a good soil mix
- ❖ Variety selection
- ❖ Planting and spacing requirements
- ❖ Fertilizing
- ❖ Watering
- ❖ Providing 5 hrs or more of full sun



Choosing a proper container

- Container made of clay, wood, plastic or ceramic
- Wooden barrels, decorative boxes, plastic garbage cans, tin cans, plastic laundry baskets etc can also be used
- Square, rectangular or circular containers work equally well
- Dark colored containers are avoided as they absorb heat and could damage the plant roots.
- Should have adequate number of holes in the bottom for proper drainage



Soil mix/ Growing media

- Best to use are the commercial potting mix which are light weight, fast draining and free of insects, diseases and weeds
- Compost is the dark, crumbly, earthy-smelling product of organic matter decomposition.
- Some good media mixtures for container vegetables:
 - 100% compost
 - 100% soil-less mix
 - 25% garden soil + 75% compost
 - 25% soil-less mix + 25% garden soil + 50% compost
 - 25% garden soil + 75% soil-less mix
 - 50% soil-less mix + 50% compost



Varieties for containers

- ❖ Varieties do not grow large but still produce good yields
- ❖ Most herbs, parsley require a standard six inch pot
- ❖ Container holding about:
 - **one gallon of soil mix:** beetroot, lettuce, onions, carrot and radish
 - **Two gallon:** pepper and small tomato varieties
 - **Four gallon or even larger:** cucumbers, eggplants, sweet corn and tomatoes



Planting information for growing vegetables in containers

Crop	Number of days for germination	Number of weeks to optimum age for transplanting	General size of container	Amount of light* required	Number of days from seeding to harvest
Beans	5-8	-	Medium	Sun	45-65
Cucumbers	5-8	3-4	Large	Sun	50-70
Eggplant	8-12	6-8	Large	Sun	90-120
Lettuce, leaf	6-8	3-4	Medium	Partial shade	45-60
Onions	6-8	6-8	Small	Partial shade	80-100
Parsley	10-12	-	Small	Partial shade	70-90
Pepper	10-14	6-8	Large	Sun	90-120
Radish	4-6	-	Small	Partial shade	20-60
Squash	5-7	3-4	Large	Sun	50-70
Tomato	7-10	5-6	Large	Sun	90-130

General care

- ❖ Plants in containers should not be crowded
- ❖ Root crops and greens should be planted on the basis of the space they need when mature, not as seedlings
- ❖ Don't overfill the media into container.
- ❖ Plants should be watered with cool, not hot, water from a hose at moderate pressure.
- ❖ Keep containers together to increase humidity and water retention
- ❖ Tall growing vegetables should be planted on the north side of the garden so that they will not shade low-growing vegetables

Rooftop Gardening

Most residential buildings in Indian cities have available roof.

But how do you build beds that will be watertight enough to keep wet earth from seeping through the roof, while still allowing drainage?

How do to build something affordable?

How to transport bags of heavy soil up?

And once up there, how to feed and water it all?

The rooftop gardening! Should be lightweight, has drainage,



Before You Begin

There are a few considerations to take into account—and they are important ones.

Load on the Roof: The first step is to evaluate your roof's loading capacity.

This is the amount of weight your roof structure can support and includes everything: planter boxes, soil (when wet), possible water storage, weight of crops at maturity, equipment and such temporary loads as people. This may be your biggest expense and will determine whether you are willing to pursue an edible roof or not. Working with a structural engineer is a must!

Tip: To grow vegetables that require more soil depth without committing to larger roof loads, use deeper containers in strategic spots (over your roof beam or posts). Always check with your structural engineer on any roof-load issues.

Sun and Wind Exposure:

Sun Exposure

Typically, rooftops receive a lot of direct sun, and most vegetables grow best in full sun (at least six hours of unobstructed, direct sunlight). veggies—such as kale, lettuce, and spinach—will fare better. with plants such as tomatoes needing at least ten.

Wind

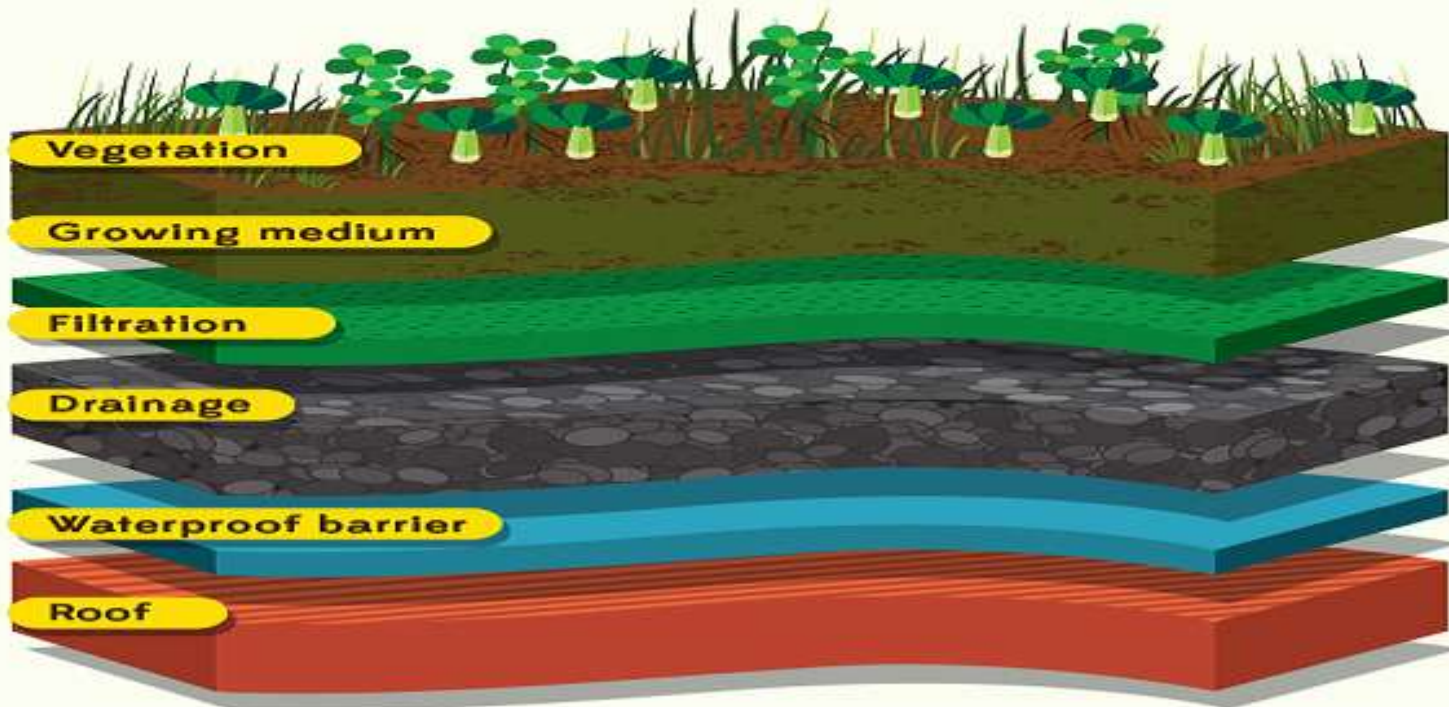
Roofs may experience more windy conditions than conventional gardens. Give some major thought into wind protection, both for the garden and passersby

Environmental Factors

Before outlining the shape of your garden, consider the type of sun and wind exposure on the roof.



ROOFTOP GARDEN DRAINAGE LAYERS



Vegetation

Growing medium

Filtration

Drainage

Waterproof barrier

Roof

Repurposing Garden Containers

Instead of converting the entire base of your roof into a garden, you could repurpose discarded materials such as old bathtubs or sinks into creative planters.



Rooftop Garden Crops Selection

► Avoid plants with thin stems

1. Ideal crops for rooftop gardens should be:
 2. a. Durable
 3. b. Capable of resisting wind and other inclement conditions.
4. Choose low-growing plants like:
Carrots, beets, turnips, lettuce, spinach,
some varieties of climbing beans.

Planning for year-round food production and food availability

- **Criteria for selecting vegetables:**

- Family preference and likely to be eaten
- Variety of vegetables with nutritional diversity
- Easy to manage
- Highly productive and tolerant to common pests and diseases

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	Sword bean	Okra
Snake gourd	Turnip	Tomato	Hot pepper
Bottle gourd			Sweet potato
Cucumber			Kangkong
			Basella

Sowing calendar (India)

Crop	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Red Amaranth		Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Radish Leaves	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Spinach		Magenta					Magenta	Magenta	Magenta	Magenta	Magenta	
Mint		Green	Green	Green	Green	Green	Green	Green	Green	Green		
Coriander Leaves		Blue	Blue	Blue				Blue	Blue	Blue	Blue	
Okra			Purple	Purple	Purple	Purple	Purple	Purple	Purple			
Cucumber		Pink	Pink	Pink	Pink	Pink						
Ridge Gourd		Black	Black	Black	Black	Black	Black	Black				
Pumpkin			Orange	Orange	Orange	Orange	Orange	Orange				
Bati Shak		Dark Green	Dark Green	Dark Green					Dark Green	Dark Green		
China Shak		Cyan	Cyan	Cyan					Cyan	Cyan	Cyan	Cyan
Green Amaranth		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow		
Kangkong		Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple	Light Purple		
Jute Leaves		Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green				
Indian Spinach		Blue	Blue	Blue	Blue	Blue	Blue	Blue				
Sweet potato		Purple	Purple	Purple	Purple		Purple	Purple	Purple	Purple	Purple	
Snake Gourd		Light Orange	Light Orange	Light Orange	Light Orange							

Crop	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Ash Gourd		Grey	Grey	Grey	Grey							
Bitter Gourd		Green	Green	Green	Green			Green	Green	Green	Green	
Yard Long Bean		Magenta	Magenta	Magenta	Magenta	Magenta	Magenta	Magenta				
Drum stick			Light Blue	Light Blue	Light Blue							
Bean			Olive	Olive	Olive	Olive		Olive	Olive			
Egg plant			Red	Red	Red		Red	Red	Red	Red		
Ivy gourd								Orange	Orange	Orange		
Lettuce		Magenta	Magenta	Magenta					Magenta	Magenta	Magenta	

Harvesting calendar

Crop	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Red Amaranth			Red	Red	Red	Red	Red	Red	Red	Red		
Radish Leaves	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow			
Spinach		Green				Green	Green	Green	Green	Green	Green	
Mint	Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple
Coriander Leaves			Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green
Turnip Leaves	Pink	Pink			Pink	Pink					Pink	Pink
Okra			Black	Black	Black	Black	Black	Black	Black			
Beet	Light Green	Light Green	Light Green								Light Green	Light Green
Cucumber			Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow		
Ridge Gourd			Pink	Pink	Pink	Pink	Pink	Pink	Pink			
Pumpkin (leaves & Fruit)			Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple	Purple	
Bati Shak	Purple	Purple	Purple	Purple				Purple	Purple	Purple	Purple	Purple
China Shak	Light Green	Light Green	Light Green	Light Green			Light Green	Light Green	Light Green	Light Green	Light Green	Light Green
Green Amaranth			Grey	Grey	Grey		Grey	Grey	Grey	Grey		
Kangkong		Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Jute			Light Orange	Light Orange	Light Orange	Light Orange	Light Orange	Light Orange	Light Orange			
Spinach			Red	Red	Red	Red		Red	Red	Red	Red	
Sweet Potato					Grey	Grey			Grey			
Snake gourd				Dark Green		Dark Green	Dark Green					

J F M A M J J A S O N D

	J	F	M	A	M	J	J	A	S	O	N	D
Ash gourd				Orange	Orange	Orange	Orange	Orange	Orange	Orange	Green	Green
Bitter gourd		Light Red	Light Red	Light Red	Light Red	Light Red	Light Red	Light Red	Light Red	Light Red	Green	Green
Yardlong bean			Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Green
Drumstick leaves	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
Bean		Orange	Orange	White	White	White	White	Orange	Orange	Orange	Orange	Orange
Eggplant			Purple	Purple	Purple	White	Purple	Purple	Purple	Purple	Green	Green
Snake Gourd				Green	White	Green	Green	White	White	White	Green	Green
Ivy Gourd			Dark Purple	Dark Purple	White	White	White	Dark Purple	Dark Purple	White	White	White
Lettuce	Blue	White	White	White	White	White	White	White	White	Blue	Blue	Blue

Benefits of a vegetable garden: To enjoy the highest quality possible by fresh harvesting

Know where your food comes from, and what goes into it

Produce as fresh as possible: more flavorful and nutritious

Grow the varieties of vegetables you want

“Better food, better health, better living-- all these the home garden offers in abundance. And the price is only the price of every worthwhile thing-- honest, cheerful patient work.”

THANK YOU!!!!





2016

Session 2



Package of Practices for Home Gardens

M. L. Chadha

Former Director

AVRDC –The World Vegetable Center

Chairman

Madan Chadha Safe Healthy Vegetable Foundation

madanchadha75@gmail.com

Select appropriate crop and variety

Proper selection of vegetable crops

- ▶ Cropping season
- ▶ Required direct and partial sunlight
- ▶ Adapted to the location

Variety selection

- ▶ Reliable and adapted
- ▶ Productive with desirable quality
- ▶ Resistant to major diseases and insect-pests
- ▶ Open pollinated or hybrids



Use good healthy seeds

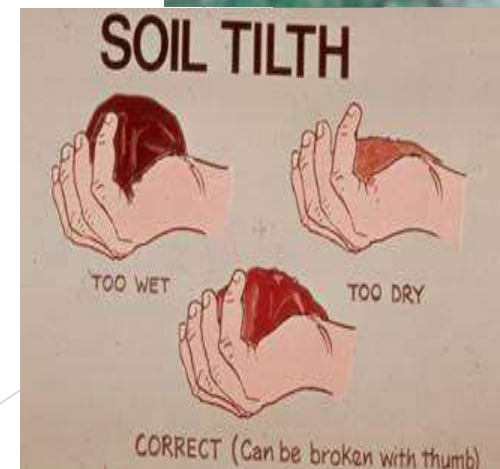
▶ Seeds

- ▶ Seed may also be a cutting, rhizome, bulb or tuber
- ▶ Free from damage, mixtures
- ▶ Free from infection, contamination,
 - ▶ with good vigour and germination capacity
- ▶ Purchased from reliable source
- ▶ Certified seeds



Manage soils

- ▶ Soil should be
 - ▶ Clay loam or sandy loam are preferred for high yield
 - ▶ equal amount of sand, silt, and clay
 - ▶ Good moisture retention capacity, well drained
 - ▶ Fertile with continuous supply of nutrients
 - ▶ Carbon nitrogen ration (C/N): 25:1 ~ 30:1
 - ▶ soil pH for most of the vegetables - 6.5 to 7.0.



Soil management practices...

▶ pH is too high (alkaline)

- ▶ Gypsum (Ca SO_4)
- ▶ Add sulfur to recommended amounts

▶ pH is too low (acidic)

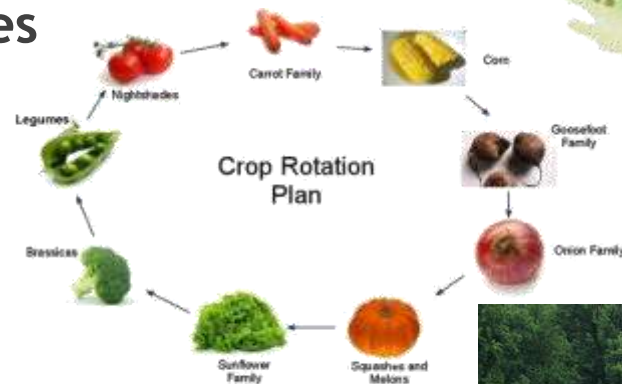
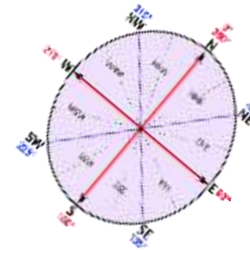
- ▶ Add lime to recommended amounts
- ▶ Sweet potato and watermelon are tolerant

▶ Salinity

- ▶ Increases concentration of water and making water & nutrient unavailable to the plants and resulting in water shortage
- ▶ Reclaim by leaching

Follow proper sowing plan

- ⊕ Home garden should be south facing
- ⊕ Rows orientation: east to west
- ⊕ Taller & trellised plants: north side
- ⊕ Shorter plants: south side
- ⊕ Crop rotation: always be followed
- ⊕ Plot sized should be according to the family need of particular vegetables



Sowing methods

- ➔ **Line sowing:** labor intensive and provide proper R x R and P x P spacing
- ➔ **Broad casting:** least labor-intensive but seedlings are not evenly distributed- may be too crowded
- ➔ **Drilling:** Drill sowing with uniform spacing: can also be mechanized
- ➔ **Sowing at high density (nursery)**
 - ➔ Prick out the extra newly emerged seedlings
 - ➔ It helps multi-picking



Planting spacing

- Ideal spacing and plant population are those that maximize yield and quality without increasing costs
- Crops increase yield as plant population is increased, but only up to a certain limit
- Appropriate spacing differs from one situation/location to the other
 - Cabbage/cauliflower are planted at a higher density if smaller heads/curds are preferred
 - Heavy and light soil
- Spacing should be little less than recommended for field crops

Sowing seed

- ◆ Prepare seed types
 - ◆ Direct sowing
 - ◆ Seedling production
- ◆ Plant in moist soil
- ◆ ½” furrow for small seed, 1” for large seed
- ◆ Mix small seed with sand
- ◆ Plant thicker than needed
- ◆ Cover lightly and firm soil over seed
- ◆ Small seeds - cover with straw



Seeding depths & seedling emergence

- ▶ **Crop planting depths (") • Days to emergence**
 - ▶ Beans 1 - 1.5
 - ▶ Beets 1
 - ▶ Chilli 0.5-1
 - ▶ Crucifers 0.5
 - ▶ Carrots 0.5
 - ▶ Sweet Corn 1 - 2
 - ▶ Cucumber 0.5
 - ▶ Garlic 1 - 2
 - ▶ Onions 0.5
 - ▶ Southern peas 2 - 4
 - ▶ Potatoes 4
 - ▶ Squash 1 - 2
 - ▶ Watermelons 1 - 2
 - Beans 5 – 10
 - Beets 7 – 10
 - Chilli 8-15
 - Crucifers 5 – 10
 - Carrots 12 – 18
 - Sweet Corn 5 – 8
 - Cucumber 6 – 10
 - Tomato 6 – 12
 - Onions 7 – 10
 - Southern peas 6 – 10
 - Spinach 7 – 12
 - Squash 4 – 6
 - Watermelons 6 – 8

General rule: 4 times the length of the seed

Healthy seedling production methods

▶ The most common and beneficial methods:

- ▶ Seed bed method
- ▶ Plug and flat tray method
- ▶ Seedling container method

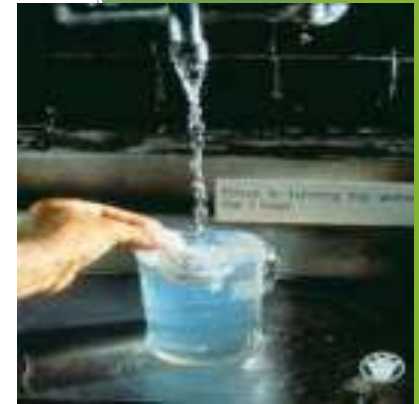


Treat the seed

Seed should be free from disease and insect pests

► Physical treatment

- Hot water, air treatment
- Cabbage- hot water treatment 45°C-20 min-black rot



► Chemical treatment

- Fungicide
 - captan/thiram @ 2-3g/kg, bavistin/ridomil 1-2g/kg
- Insecticide
 - imidaclopride 1ml/kg



► Biological treatment

- Special treatment
- trisodium phosphata 10% solution for TMV

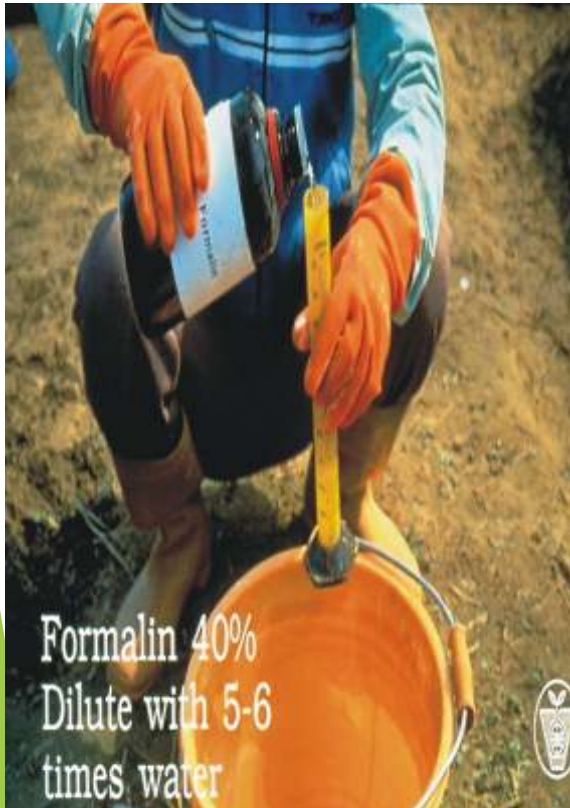


Bed preparation



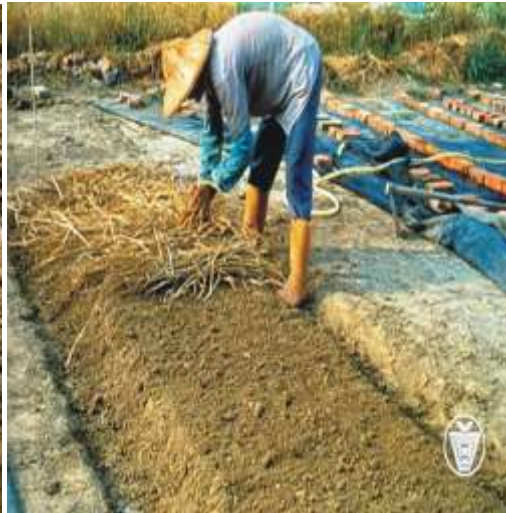
Chemical sterilization

► Formalin treatment



Maintenance

- ▶ Sow the seeds separately in 0.5 to 1 cm deep furrows
- ▶ 50-65 seeds in one furrow as an average of 750-900 seeds per square meter are
- ▶ Cover the seeds with the nursery soil or compost
- ▶ Put the rice straw
- ▶ Irrigation (fine sprinkler or spraying)
 - ▶ Daily during the hot and dry season
 - ▶ On alternate days in the cool season
 - ▶ Excess watering should be avoided

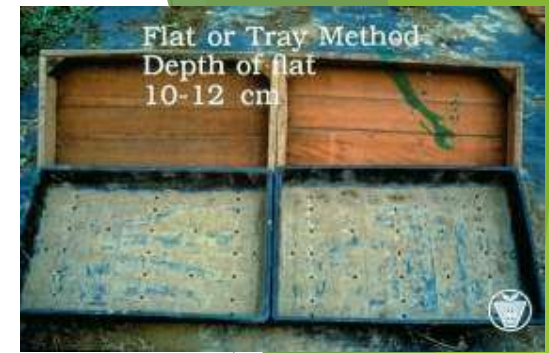


Plug or flat tray method

► Containers

- 10- to 12 cm deep plastic or wooden flat's tray
- plug tray with 50/72 or 90/128 number of holes with size 4-cm deep and 4.6-cm diameter

Seed sowing



Potting media

- ▶ Soil: compost: sand : smoked rice hulls (5:3:1:1)
- ▶ Coco-peat: vermiculite: perlite (3 : 1 : 1)
- ▶ Compost/potting mixture: soil: sand (3 : 1 : 1)
- ▶ Compost:sterilized rice hull/husk :sand (3 : 1 : 1)



Maintenance

- Covering the plugs with fine compost
- Putting nylon mesh screen and irrigation
- Thinning



Seedling container method

- ▶ Perforated plastic/ polyethylene/ bio-degradable bags 5-7 cm wide and 10 cm long



Root trainers

Transplanting stage

- ▶ Tomato, pepper and eggplant
 - ▶ 3-6 open true leaves with stem height of 10-15 cm
 - ▶ Cabbage, Chinese cabbage, cauliflower, kohlrabi and lettuce,
 - ▶ 4-5 true leaves, 3-5 weeks.
- Water to settle soil; add more soil



Advantages

Healthy and quality seedlings

6-7 days early nurseries for transplanting

7-13 days early harvesting

Low soil borne disease incidence

Almost no viral diseases incidence

Low field disease after transplanting

Yield increase of 34 to 54.5%

Could be a profitable agribusiness



Ideal conditions for transplanting

- A cloudy, cool weather and moist but not wet soil are ideal for transplanting
- During sunny days, transplanting is best done in the late afternoon to give time for the seedlings to recover at night
- Seedlings should be properly hardened
- Adequately hardened seedlings with slightly damaged roots recover well when transplanted even in a hot day
- Set transplants slightly deeper than they are in the container



Plant companion crops

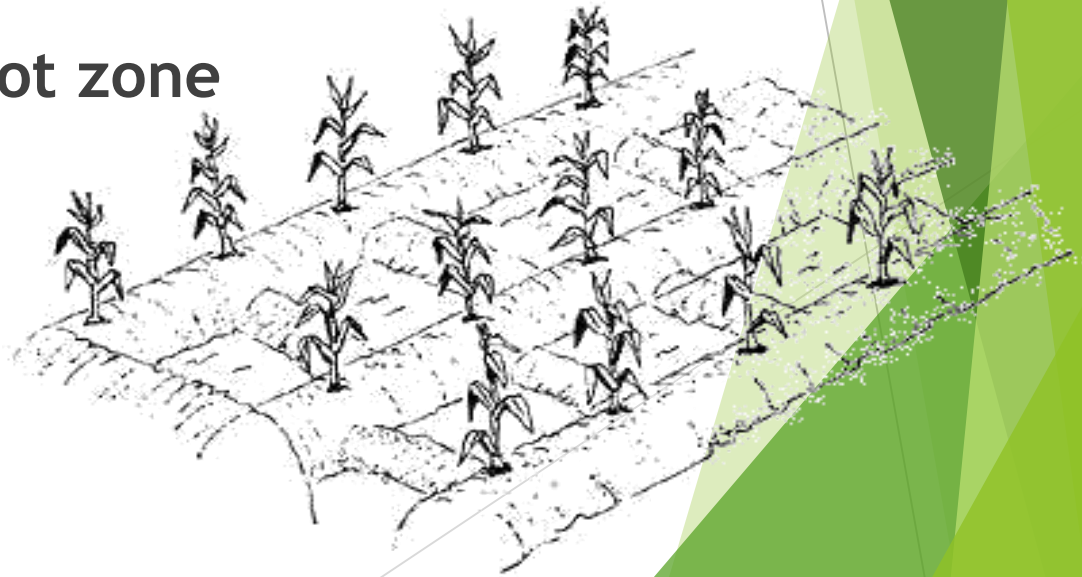
Main crop	Companion crop	Non-Companion crop
Asparagus, beans	Tomato, parsley, basil, potato, carrot, cucumber, cauliflower, cabbage, most other vegetables and herbs	Onions, garlic
Bottle gourd, Bush beans	Sponge gourd, cucumber, bitter gourd, potato, cucumber, corn, celery	Onion
Pole beans	Corn	Onion, beet, kohlrabi
Potato	Beans, corn, cabbage	Squash, cucumber, tomato, potato
Cucumber, turnip	Pole beans, radish, okra, eggplant, beans, corn, peas, radish	Potato
Tomato	Carrots, Onions, Parsley, Nasturtium, Asparagus, Cucumber	Cabbage, Cauliflower, Fennel, Potatoes
Beets, Brassica	Onion, kohlrabi, potato, celery, tomato, mint, beet, onion	Pole beans

Weed control

- ▶ Don't delay! Remove weeds when they are less than 1" tall and remove roots, too!
 - ▶ Hand weeding
 - ▶ Hoe weeding
 - ▶ Mulching
 - ▶ newspaper, straw, leaves, black polyethylene plastic, grass clippings, wood chips (nontreated) work well
 - ▶ Chemicals- READ directions! BE careful! Not most desirable for edible plants
- ▶ Proper plant spacing

Water management

- ▶ Careful watering should be done until the seedlings have emerged, especially when the seeds are small
- ▶ Watering should be done preferably in the morning
- ▶ Ridges help keep water away from plants and lead it directly to the roots
- ▶ Insufficient water at any growth stage will reduce yield and fruit quality
- ▶ Place water at the root zone



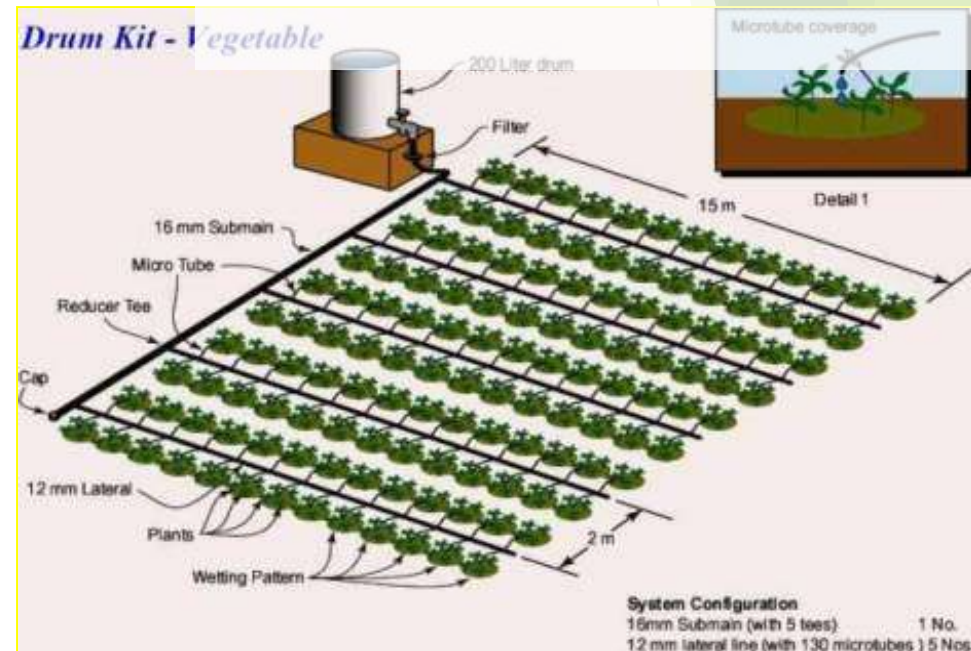
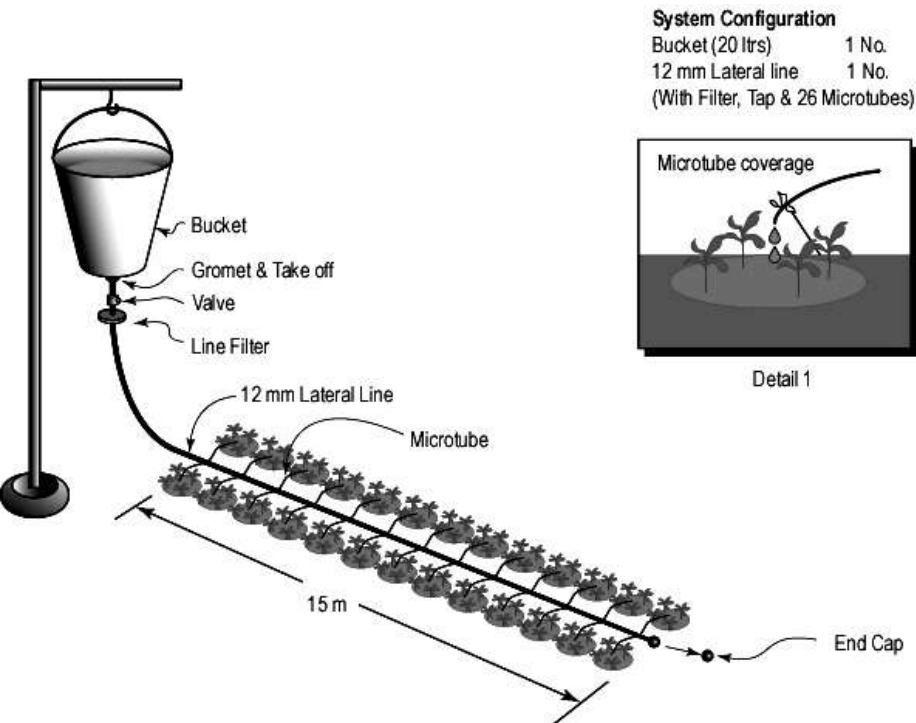
Bucket & Drum kit technology

Irrigation

- ▶ Irrigation can be from safe water source
- ▶ Home waste water
- ▶ If possible small drip irrigation facilities

➤ Rs. 300-500 for 1 “Bucket Kit” which will irrigate 25-125 sq. m

➤ Rs.3000 “Drum Kit” will irrigate 125-500 sq. m



Fertilizer management

- **Decomposed OM or fertilizers must be mixed in the soil before sowing**
- **Late application may cause temporary nutrient deficiency**

Fertilizing: application

▶ High nitrogen crops

- ▶ Leafy vegetables and corn

▶ High phosphorus crops

- ▶ Pod and fruit crops

▶ High potassium crops

- ▶ Root crops

▶ Soil builders (good for rotation)

- ▶ Broad beans, lima beans, snap beans, clover, peas, peanuts, soybeans, southern peas (black-eye).

1. Broadcasting
2. Side dressing
3. Banding
4. Plowing under

Use mulching

- ▶ Organic mulching (straw, grass clippings, leaves, compost and rotted sawdust)
- ▶ Plastic mulching
- Reflective mulches (such as silver-colored plastic that reflects light) are said to be effective in repelling insects

Mulch benefits

- Conserves & maintains soil moisture
- Reduces nutrient leaching
- Maintain soil temperatures and moderates them



Use proper staking and training

Advantages

- ▶ Optimum use of spacing
- ▶ Facilities management operations: irrigation inter-tillage, pest control, and harvesting
- ▶ Lessen contact of fruit with soil
- ▶ It also helps produce better products

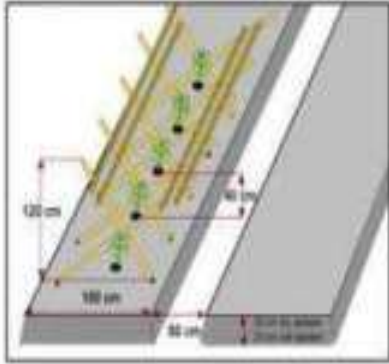
Three types of plants for staking

- ▶ Plants with special structures: tendrils which allow them to climb-cucurbits
- ▶ Plants that twine: yard-long beans
- ▶ Plants that do not have the natural ability to climb and must, therefore, be tied to the stakes-tomato, capsicum

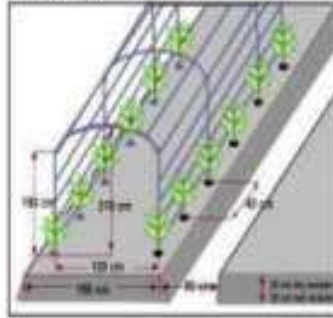


Staking types

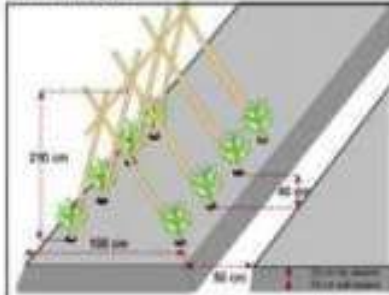
A. Cradle type



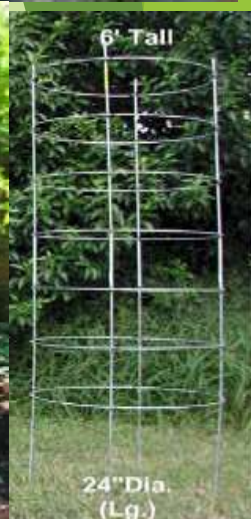
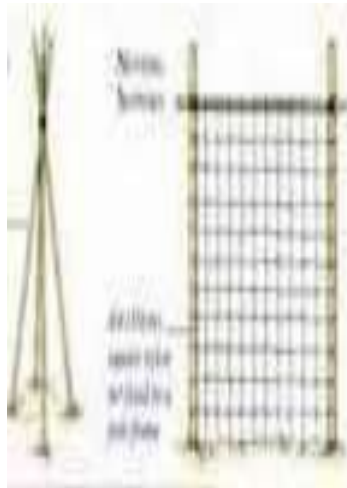
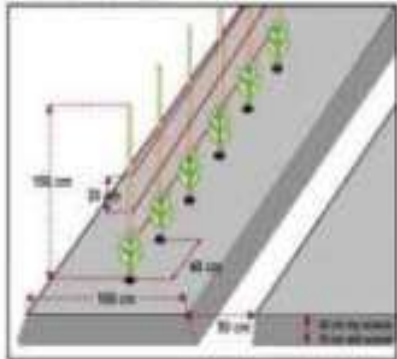
D. Tunnel type



B. Lean-to type



C. Conventional type



Pruning

The degree of pruning varies according to the season

In indeterminate tomatoes

- ▶ pruning results in single-stem plants which can easily be tied to the stake

In the case of cucurbits, *Luffa*

- ▶ 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
- ▶ Okra, chilli and eggplant during the wet season

Tools for small scale mechanization in home gardens



DEEP JYOTI GARDEN TOOLS
ISO 9001-2008 Certified Company

DEEP JYOTI GARDEN



Shovel and spade

- ♣ **Shovel:** for lifting, turning, and moving soil
- ♣ **Spade:** for edging beds, digging holes for planting, slicing under turf and working soil improvements into the garden.



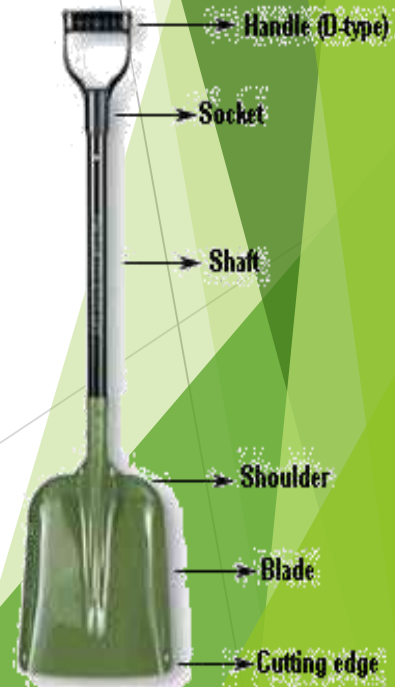
Trenching



Drain Spades



• Scoop:



Spading fork/ trowels

- Breaking up, turning and aerating the soil compacted soil after digging
- Pricking over and loosening the surface lifting root vegetables, shifting compost and manure.



Rake

- ♣ used for leveling and grading soil, stirring up the soil surface, and removing clumps, rocks, and shallow-rooted weeds.



Hoe

- ❖ Making rows, making drills, digging the soil, earthing up, chopping of weeds



Triangular Hoe



Draw Hoe



Dutch Hoe



Digging Hoe



Combination Hoe



Cultivator

- The blade lifts the soil and cuts the weeds.
- Effectively slice and loosen up ground prior to finer cultivation.
- Dig the tines into the soil and draw toward you.
- For loosening the top 4 inches of soil



Hand weeders: to remove weeds from crevices such as those found between paving slabs.



Cutting and pruning

- Cutting large branches and logs or for felling trees.

Clipping hedges, cutting long grasses, herbaceous plants or trimming topiary.

Chainsaws



Hedge trimmers

Chopper



Pruning Saws



Shears



Knives



- ✓ Light pruning, cuttings
- ✓ Grafting, budding or even pruning
- ✓ Cutting twine
- ✓ Harvesting fruit or certain types of vegetables

Anvil secateurs

Secateurs

Parrot-Beak secateurs

By-pass secateurs



Loppers and Pruners

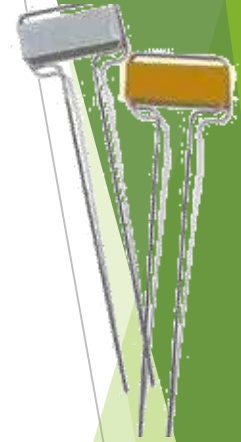
- Removing small branches and stems or for cutting through thinner branches of trees that are difficult to reach.

Tree pruner:



Labels and Markers

- Plastic or metal markers to label plants for future reference
- Should be weather-resistant and durable enough to last at least a season



Plant pots and pans: urban cultivation

- Plant pots: made from either clay or plastic
- Plastic pots should be made from a mix of polypropylene and polythene to avoid deterioration in the cold weather.



Planting and Sowing Aids

- ◆ **Plungers:** Inserts a seed to a fixed depth.
- ◆ **Wheeled Seed Sowers:**
- ◆ **Seed Tray Sowers:**
- ◆ **Dibbers:**



- ◆ **Bulb Planters:**



◆ Staking aids: Plant cages, Ties and Supports



Watering Tools

Water Butts



Good for seeds and seedlings as the spray will not damage them or wash away the compost



Water Cans



Sprinklers



Integrated Pest Management Practices for Home Garden Vegetables

Constraints

- ▶ **HG insect-pests:**
 - ▶ **Weeds:** plants that are growing out of place
 - ▶ **Insects:** enormous number of species
 - ▶ **Diseases:** fungi, bacteria, viruses, nematodes
 - ▶ **species of wildlife**



Problems

▶ Abiotic (no-infectious)

- ▶ Poor plant nutrition, misuse of pesticides also can cause injury to plants.

▶ Biotic (infectious)

Many problems are initially caused by

- ▶ improper planning
- ▶ extreme temperature,
- ▶ water logging or drought,
- ▶ improper use of fertilizers
- ▶ overuse of chemicals
- ▶ improper sanitation
- ▶ damage caused by lawn mowers,



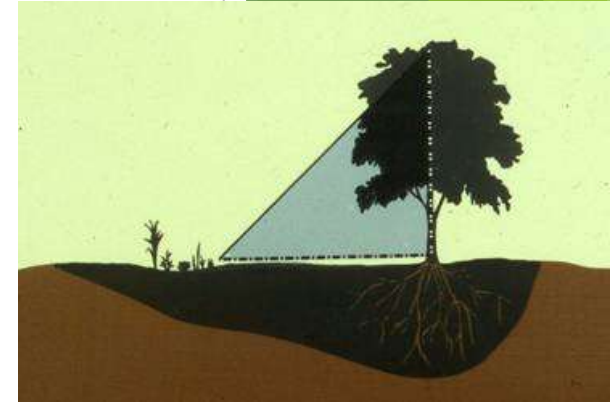
Changes to the environment

▶ Site selection

- ▶ South direction
- ▶ Free from shade of big trees

▶ Direction of planting

- ▶ Row east-west direction
- ▶ shorter plants towards south direction



► Cleaning: remove food for pests:

- Destroy infected plants/fruits, unfruiting old branches -chilli, eggplant
- Removing weeds/infested plant debris:
- Use soil solarization and flooding



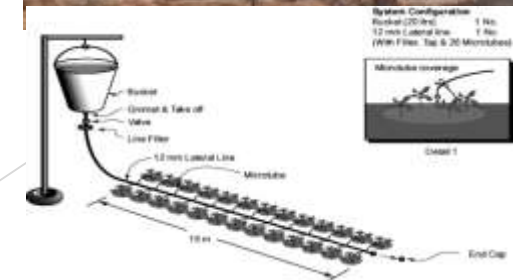
▶ Cultural practices: ensure healthy plants growth

- ▶ select the plants that are adapted to the conditions
- ▶ Inter culture to expose soil-inhabiting grubs and pupae
- ▶ Proper plant spacing and aeration
- ▶ Staking & Mulching



Prevention

- ▶ **Crop rotation:** soil borne diseases, soil insects, nematodes, and toxic chemical residues tend to collect, build up in a given area
 - ▶ Avoid planting the same crops in the same area
 - ▶ Avoid same family crop
 - ▶ Change tall crop with small crop
 - ▶ Change non-leguminous crop with leguminous crop
 - ▶ Avoid over and afternoon/evening watering



Protection

- ▶ Net cover of 2 m height can be put surrounding the home garden to protect from insect-pests
- ▶ At the early stage of cucurbit, tomato, chilli growth the plot can be covered with plastic tunnel to protect the crop from frost injury
- ▶ Putting straw/plastic mulching reduce the insect -pest multiplication and spread
- ▶ Grow companion crops to keep some insects away



Plant companion crops

- ▶ Basil/Osmium- flies, mosquito, tomato borer
- ▶ Garlic - beetles, aphids, weevils, spider mites
- ▶ Radish - cucumber beetle
- ▶ Mint - cabbage moth
- ▶ Marigold - beetles, cucumber beetles, nematodes
- ▶ Nasturtium - aphid, beetle, squash bug
- ▶ Rosemary - cabbage moth, bean beetle, carrot flies



Control

- ▶ **Treatment:** knowledge of the types of control methods available, and or alternative control methods;
- ▶ suppressing pest populations to acceptable levels using strategies based on considerations of:
 - ▶ Physical, biological, cultural, mechanical, behavioural and chemical controls in appropriate combinations, and
 - ▶ environmental and human health protection;

Damping off *Pythium* spp.; *Phytophthora* spp.; *Rhizoctonia* spp.

- **Caused by several soil-borne fungal pathogens**
- **Infection starts during seed germination (pre/post)**
- **Infected tissues become rotten and seedlings collapse.**



Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Use clean seeds	***
Pathogen reduction	Remove and destroy infected plant, soil solarization, sterilization	*
Host resistance	Use locally effective resistant cultivars	**
Direct protection	Fungicide: Captan, mefenoxam, fludioxonil + mefenoxm Biological control agent: <i>Trichoderma</i> spp. <i>Pseudomonas</i> spp	***

Tomato Fusarium Wilt

Fusarium oxysporum f.sp. lycopersici

- **A soil-borne, vascular disease**
- **The pathogen can survive in the soil for a long period.**
- **3 major races are reported.**



Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Use clean seeds,	***
Pathogen reduction	Remove and destroy infected plant, crop rotation, soil solarization, sterilization raise pH 7	*
Host resistance	Use locally effective resistant cultivars	**
Direct protection	Fungicide: Captan, mefenoxam, fludioxonil + mefenoxm Biological control agent: <i>Trichoderma</i> spp. <i>Pseudomonas</i> spp	***

Bacterial Wilt

Ralstonia solanacearum

- *A soil-borne, vascular disease*
- *The pathogen can survive in the soil for a long period and has a very wide host range.*
- *Highly diverse strains*



Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Use a plot without disease history Use clean seedlings Not contact with contaminated water	***
Pathogen reduction	Practice crop rotation; Remove diseased plants; Apply soil fumigation or amendments-urea, Ca(OH) ₂	**
Host resistance	Use locally effective resistant cultivars	***
Direct protection	Use sterilized pruning tools	*

Tomato late blight

Phytophthora infestans

- ***Soil borne, cool and wet weather favors disease development.***
- ***Symptoms can be seen on all above ground parts.***
- ***Several races have been reported.***



Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Raise healthy seedlings, select disease free area,	**
Pathogen reduction	Remove and destroy infected plants Sterilize the soil use, use bio-pesticide as soil application	***
Host resistance	Use locally effective resistant cultivars	***
Direct protection	Apply bio-chemical pesticide etc.	**

Alternari leaf spot/ Early Blight *Alternaria spp*

- ***A foliar, seed-borne disease prefers warm and humid conditions***
- ***Symptoms start from older leaves.***
- ***3 major races are reported.***



Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Use clean seeds, Avoid extended period of leaf wetness.	**
Pathogen reduction	Remove and destroy infected plant, crop rotation,	*
Host resistance	Use locally effective resistant cultivars	**
Direct protection	Apply protective fungicides when disease is just start	***

Downy mildew

- *Soil borne, foliar disease*
- *Angular yellow spots on upper leaf surface, with grayish, moldy growth on lower surface.*
- *High humidity & leaf wetness*

Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Raise healthy seedlings, select disease free area,	*
Pathogen reduction	Remove and destroy infected plants Sterilize the soil , use proper plant spacing	**
Host resistance	Use locally effective resistant cultivars	***
Direct protection	Apply bio-chemical pesticide etc. when disease is just start	**



Powdery mildews:

- ▶ *Soil borne, foliar disease*
- ▶ *yellow-greyish spots, which turned into necrotic spots.*
- ▶ *Powdery growth occurs on both surface, result in premature defoliation reduced plant growth*

- **Treat the seed**
- **Do not allow leaf wetness.**
- **Enrich soil with organic matters will enhance soil moisture retention.**
- **Apply bio-chemicals**
- **Resistant cultivars**



Tomato yellow leaf curl

Whitefly transmitted

begomovirus

- **Transmitted by whitefly**
- **Not seed-borne**
- **Early infection results in no yield.**
- **Diverse virus species**



Control principles	Specific control measures	Potential efficacy
Pathogen exclusion	Raise healthy seedlings by protection with 60-mesh net, avoid transplanting at high pest population	***
Pathogen reduction	Control insect vectors, whitefly, with pesticide, trap crops, and/or traps Remove and destroy infected plants	*
Host resistance	Use locally effective resistant cultivars	***
Direct protection	Apply summer oil, neem extract etc on leaves	*



Blossom end rot

- *The symptom is caused by localized deficiency of Ca in the fruits induced by unfavorable growth condition, particularly drought.*



- **Maintain constant soil moisture in the field.**
- **Enrich soil with organic matters will enhance soil moisture retention.**
- **If Ca is deficient in the soil, apply lime 2 to 4 months before planting.**



Sun scald

- *The symptom is caused by sudden exposure to intense sunshine at high temperature and high humidity.*
- *The exposure could be due to pruning, defoliation, severe foliar diseases.*
- *Mature green and breaker tomatoes are more susceptible.*

- Maintain good foliage growth and coverage.



Eggplant fruit & shoot borer-IPM

- Use healthy seedling production technology, installation of pheromone traps two weeks after transplanting (at 10 m distance) followed by shoot clipping
- Reduces 38% eggplant fruit and shoot borer infestation and enhanced the yield by 121 %



DBM

- ▶ Infect most of the brassica family crops
- ▶ Infect, head & curd



White flies: *Bemisia tabaci*

- The affected leaves curl and dry up. The growth of the plant is stunted.
- Whiteflies act as a vector, transmitting leaf curl virus causing severe loss in yield. Loss may be even 80–90%.



Nematodes



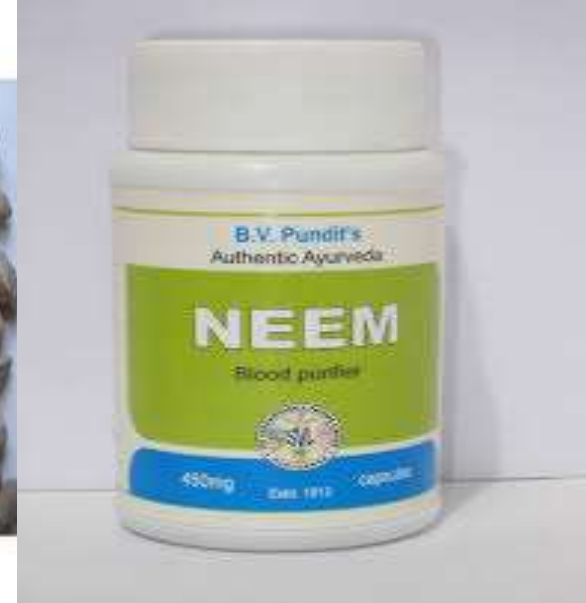
Pest management

- ▶ Regularly monitor the crops for insect-pest
- ▶ If necessary apply the control measures
- ▶ Always prefer biocontrol or IPM practices
- ▶ Apply the pesticide wherever it is needed
- ▶ Do not apply broad spectrum insecticide to prevent biocontrol insects
- ▶ Follow the label instruction properly



Pest management

- ❖ Prevention/eradication by prevailing traditional practices
- ❖ **Biological/physical/ natural pest / disease control**
- ❖ **Neem products**
- ❖ **Pheromones**
- ❖ *Trichoderma viride* –bio-control



Harvesting vegetables

Much of this advantage can be lost if vegetables are not harvested at the proper stage of development.

Harvest quality

- ▶ Appearance
 - ▶ size and shape
 - ▶ color
 - ▶ gloss
 - ▶ blemishes
- ▶ Texture
- ▶ Flavor
- ▶ Nutritive Value
- ▶ Safety



Prepare soil: for quality harvesting

- ▶ Soil nutrients influence the keeping quality
- ▶ **Best soil:** deep well drained, fertile with plenty of organic matter.



- **Nitrogen:** provides optimum development of vegetable color, flavor, texture and nutritional quality
 - Excess N: hollow, weight loss of sweet potato, hollow stems in broccoli, branched carrots
- **High levels of P :** increase sugar concentrations of fruits and vegetables while decreasing acidity.
- **High levels K:** create better quality vegetables-Increases the vitamin C of vegetables, Improves vegetable color

Edible plant part : stage

According to the part of the plant being eaten

- Some of the vegetables may fall into more than one category as more than one part of the same plant is eaten. These are classified as:

❖ Leafy Vegetables:

- Edible parts: leaves.
- These include: amaranth, malabar spinach, bathu, chulai, kale, lettuce, sorrel/chuk, spinach, fenugreek, kangkong



❖ Bulb, Tuber and Root vegetables:

Bulbs usually grow just below the surface of the ground and produce a fleshy, leafy shoot above ground. Bulbs usually consist of layers or clustered segments.

- These include: Onion, Garlic, Shallot.

Tubers are vegetables which grow underground on the root of a plant.

- These include: sweet potatoes, potato, yam, taro

Roots are a long or round-shaped taproot.

- These include: asparagus, kohlrabi, beetroot, carrot, cassava, radish, turnip



❖ Podded vegetables:

- They include all the varieties of beans, peas, and lentils.
- Like... black-eyed pea, faba bean, drumstick, dolichos bean, french bean, pea, lima bean, moth bean, mungbean, rice bean, runner bean, soybean, sword bean, velvet bean, winged bean, yardlong bean



Based on use, botany and cultural requirements

Vegetables with similar cultural requirements grouped together into one.

- **Potherbs/ greens:** amaranth, spinach, night shade, mustard, kale
- **Salad crops:** lettuce, celery, water cress
- **Cole crops:** cabbage, cauliflower, broccoli, brussels sprouts, kohlrabi, chinese cabbage
- **Root crops:** carrot, radish, turnip, beet root
- **Bulb crops:** onion, garlic, shallot, leek
- **Pulses:** beans, peas
- **Tuber crops:** yams, sweet potato, cassava
- **Cucurbits:** watermelon, cucumber, pumpkin, squash, muskmelon
- **Solanaceous fruit vegetables:** tomato, eggplant, sweet pepper, hot pepper
- **Perennial vegetables:** Moringa, bamboo shoots, taro, asparagus



Based on life cycle

- Most vegetables are **annuals** and complete their life cycle within one growing season
- **Biennial** vegetables require two seasons for completing their life cycle
- Many cole crops such as cabbage, cauliflower, broccoli and root crops such as carrot are biennials but are grown as annuals
- **Perennial** vegetables complete their life cycle in more than two years
- Asparagus is grown as a true perennial
- Tomato, eggplant, pepper and sweet potato are perennials in their native environment but are grown as annuals for production

According to seasons/temperature requirements

Two categories based on the temperatures which produces optimum growth: **cool season** and **warm season** vegetables.

Warm season vegetables cannot withstand cold temperatures

- Adapted to 18-30°C, intolerant to frost and mostly grown for edible fruits
- Include: **yardlong bean, amaranth, cucurbits, sweet corn, okra, eggplant, melons, pepper, squash**
- **Cool season vegetables** have optimum growth under cool temperatures (15-18°C), are shallow rooted and small-sized.
- Include: **cabbage, brussels sprouts, onion, garlic, carrot, beet root, spinach, turnip, broccoli, radish, cauliflower**

Days to first harvest

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

Harvesting facts

- **Timing**

- Harvest early in the day
- Dry and cool weather is the best

- **Quality is reduced by**

- Improper temperature
- Drying
- Mechanical injury
- Disease

- **Premature harvest reduces amount of flavor compounds.**

- **Late harvested may result in a fibrous, less tender, bland or bitter crop**



Tomato

- ▶ Pick when fully colored, but firm.
 - ▶ Once fully colored, it will be in the prime eating stage for about a week.
 - ▶ Overripe fruits become mushy, lose flavor.
- ▶ Never refrigerate tomatoes - won't fully develop flavor after harvest
- ▶ Wraps unripe fruit in a paper bag out of direct sunlight



Eggplant



- ▶ Harvest 25-40 days after flowering.
- ▶ Harvest glossy and deeply colored, feel heavy for its size.
- ▶ Over mature fruit will have a dull skin flesh will be bitter.
- ▶ Clip fruit rather than pulling from the plant to avoid damage



Peppers

- ▶ Harvest immature or mature.
- ▶ Hot peppers can be dried.
- ▶ Avoid harvesting peppers with sunken brown spots.
- ▶ Store fresh peppers in the vegetable crisper section of the refrigerator.



Okra

- ▶ One week after flowering
- ▶ Tender fruits with dark green colour
- ▶ Surface with hairy feel
- ▶ When fruit tip can be easily broken
- ▶ Give multi picking



Beans



- ▶ The bean pods are edible at any size and are of good quality until the bean is nearly full size,
- ▶ **Harvest 14-18 days after full bloom.**
- ▶ Should be sweet, tender and uniform size and when half developed in the pod.

Garden pea

- ▶ Harvest peas 3 weeks after full bloom.
- ▶ Pod size and number of seeds/pod may differ according to variety
- ▶ **Don't allow to get over ripe.**



Cucumbers

- ▶ Harvest slicing cucumbers when they are 6-8 inches long (typically 12 days after pollination).
- ▶ Oversized (yellow) fruit left on the plant will prevent subsequent fruit from developing & will have large seeds.



Bitter gourd/bottle gourd

- ▶ When bitter gourds: 10-15 days after pollination
- ▶ When bottle gourd: 7-10 days after flowering
- ▶ Oversized (yellow) fruit should not be harvested



Melons

- ▶ Harvest muskmelons at full-slip.
- ▶ Cool immediately to prevent deterioration.
- ▶ Observe the “ground patch” on watermelon to determine when to harvest - it will become white to creamy yellow.



Pumpkins



- ▶ Harvest 2-4 months after planting.
- ▶ Outer skin should resist fingernail pressure.
- ▶ Leave a 3” handle.
- ▶ Cure by exposing them to temps of 80°F for 7-10 days.
- ▶ Store at 40-45 °F for up to 2-3 months.

Lettuce



- ▶ Can be harvested at the time of thinning to full leaves development
- ▶ Harvest individual leaves or bunches of leaves
- ▶ Harvest lettuce heads by cutting and remove any damaged leaves.
- ▶ Don't wash until just prior to use.

Spinach/ Mustard/Kangkong, basella, amaranth

- ▶ 35-50 days after planting.
- ▶ 5-7 leaves per plant.
- ▶ Remove outer leaves first.
- ▶ Can be harvested at the time of thinning to full leaves development
- ▶ Harvest individual leaves or bunches of leaves
- ▶ Continued harvest or multi cutting until seed stalk forms.



Cauliflower

- ▶ Harvest when curds are compact and surrounded by leaves.
- ▶ Retain enough wrapper leaves to hold heads intact.



Cabbage

- ▶ Harvest when heads are firm and before heads split.
- ▶ Cut with a sharp knife just above the root crown.
- ▶ Don't wash prior to storage.



Broccoli

- ▶ Harvest when heads are firm and florets haven't begun to open.
- ▶ Retain 2-4 inches of stem when cutting.
- ▶ Cut sprouting broccoli just below the floret to stimulate new shoots.
- ▶ Cool immediately after harvest.



Carrots

- ▶ Harvest when they are sweet and before they become woody
- ▶ Carrots with large shoulders are often woody
- ▶ Carrot can be harvested 3-4 times
- ▶ Wash well before storing in a plastic bag in the refrigerator



Radishes



- ▶ Radish can be harvested two or three times
 - ▶ At the time of thinning
 - ▶ At the time of second thinning once the roots are developed
 - ▶ At the time of fully mature for eating
- ▶ Winter radishes are harvested 50-60 days after planting.

Beets



- ▶ Can harvest and eaten the green tops that are thin out of the rows.
- ▶ Harvest when beets are round and tender. Old, large roots can be fibrous.
- ▶ 50-60 days after planting.
- ▶ May store for up to 6 months in the refrigerator.

Garlic

- ▶ Harvest garlic when 2/3 of the tops turn brown - 9 months after planting.
- ▶ The garlic tops will fall over and begin to brown when the bulbs are ready.
- ▶ Dig, don't pull, and allow to dry before storing.
- ▶ Cure for 30 days in a warm, dry place.
- ▶ Hardneck garlic will last for 3-6 months.
- ▶ Softneck garlic lasts for 6-9 months.



Onions

Green onion

- ▶ Harvest green onions when the tops are > 6" and ½-1" in diameter.
- ▶ Two -three thin outs can be utilized

Bulb onion

- ▶ Harvest bulb onions when 50-75% of the tops fall over.
- ▶ Cure bulb onions at 30-32 °C for 10 days



Reduce the risk of contaminating vegetables grown in your gardens

- ▶ Clean soil:
- ▶ Clean water:
- ▶ Clean hands:
- ▶ Clean surfaces:

Humans are major source of disease transmission in food.

Home-scale seed production and storage

Why produce seeds in a home garden?

- Advantages of producing seeds:
 - Production is cheap
 - Seeds are available at any time
 - Gardeners can be independent
 - Quality is assured
 - No difficulty in procuring small quantity of seeds
- Main problem in vegetable cultivation is obtaining good quality seeds

Producing seed in a home garden

The home gardener must consider the following:

- Seeds should be saved from healthy, vigorous plants only.
- The plants from which seeds are to be saved should be marked and observed during the whole growth period.
- No seeds should be extracted from diseased and/or pest-infected plants. Undesirable plants should be removed.
- If large amounts of seed are required, a plot should be reserved for seed production alone, in isolation from other similar crops.

General aspects of seed production

- **Selection of a right variety:**

- A vegetable variety grown for seed production must be genetically pure and adapted to the photoperiod and temperature prevailing in the production areas.

- **Selection of suitable areas for seed production:**

- Areas selected for seed production should be under the agro-climatic zones with moderate rainfall (30-40), humidity (40-50% RH), temperature (15-20°C), and gentle winds.

How to keep seeds pure?

1. Isolation distance:

- Genetic purity of the seed is another important character of a good quality seed.
- This can be maintained year after year if adequate isolation distance is provided to the seed crop.
- In the **self-pollinated crops**, an isolation distance of **25 to 50 m** may suffice to avoid mechanical mixture at the time of planting or harvest.
- The **cross-pollinated crops** require an isolation of **400 to 1600 m** depending upon the amount and type of out crossing.

Types of seeds required

- **Hybrid seeds:** These are purchased and expensive. They require significant inputs to produce a superior yield
- **Open-pollinated seeds (OP seeds):** It is easy for home gardeners to maintain the quality of seeds for self-pollinated vegetables. There is more challenge for cross-pollinated vegetables which tend to become modified and diversified.

Pollination: Three ways of pollination: Self-pollination, Cross-pollination and Partial cross-pollination

Vegetable	Mode of Pollination	Pollination medium
Red/green amaranth	Cross	Wind
Radish, carrot, beet, turnip	Cross	Insect
Cabbage, cauliflower, broccoli, kohlrabi, mustard	Cross	Insect
Pumpkin, ash gourd, bottle gourd, snake gourd, bitter gourd, ridge gourd, cucumber, melon, watermelon	Cross	Insect
Tomato, chilli, capsicum	Self	Insect
Okra, eggplant	Partial Cross	Insect
Kangkong	Cross	Insect
Spinach	Cross	Insect/Wind
Basella	Cross	Wind
Beans, french bean, yard long bean, soy bean, dolichos, cowpea	Self	Insect
Lettuce	Self	Insect

● Harvesting of seeds:

- Seed crops of vegetables grouped according to the state of the seed at harvest:
- Clean seeds are dried to about 8% moisture

1. Dry seed: The seeds are not harvested when the fruits ripen but are left to dry on the plant. Examples: beans, *Brassicas* *Luffa* species, okra, onion, lettuce, carrot, kangkong and sweet corn.

2. Seeds of fleshy fruits: There are two types of seeds under this group:

- (a) Seeds with mucilaginous coating** - Examples: tomato and cucumber
- (b) Seeds without mucilaginous layer** - Examples: pepper, eggplant, melon and squash

Maturity indices of some vegetables:

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, hard & 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

Important features in seed production of vegetable crops

Tomato	Good sized, well ripe fruits free from diseases are selected.
Brinjal	Harvest the fruit when they are greenish yellow or brown. Floating seeds should be rejected. Dry the seeds in partial shade immediately.
Chilli & Capsicum	Sweet pepper (Capsicum) readily crosses with hot Chilli. Both types are not grown for seed production at the same time at the same farm. Harvest at the red ripe stage and dry.
Radish	For quality seed, the roots are to be pulled out, examined and the best root then replanted cut $\frac{2}{3}$ top and $\frac{1}{4}$ root.
Turnip	It crosses readily with mustard; proper isolation has to be given.
Okra	Select pods after 3 nodes.
Amaranthus	Seed crop is harvested when most of the leaves turn yellow.
Cucurbits	<p>The following groups of crops should not be grown together for seed production; Muskmelon - Long melon, Watermelon, Round melon, Sponge gourd - Ridge gourd.</p> <p>Bottle gourd, sponge gourd and ridge gourd - extract seeds from dried fruits.</p> <p>Pumpkin, cucumber, bitter gourd, ash gourd - extract seed from ripe fruit.</p>

Seed Extraction in various vegetables

Tomato



Extracting seeds with hand



Slurry



Rinsing seeds



Preparing seeds for drying in an oven



Drying seeds in partial shade



Dried seeds

Okra

- The dry pods should be harvested for seed before shattering.
- The seeds are threshed out from the pods by beating with sticks or by passing rollers.
- The seeds are cleaned and dried to a moisture content of 8-10%.



Luffa

- In case of dry fruits, the seed is extracted by breaking open the fruits by making hole at the blossom end of the fruit.
- After washing/cleaning, the seeds should be dried under sun or in seed driers.
- Moisture content should be reduced to 6-8% for safe storage.

Mature luffa gourd fruits



Cucumber : Wet seed extraction



(1)

(2)

(3)

(1) Mature cucumber

(2) Seed extraction

(3) Fermenting seed: Natural fermentation takes one to two days at a pulp temperature of 22 - 27°C, and two to four days at 15-22°C.

Radish

- Radish pods turn brown when they are ready to be harvested
- pods are seamless or indehiscent
- Rub them between the palms of your hands to release the seeds
- Winnow out the lighter pieces of stem or pod that is introduced along with the seed.



Pea

- Harvest when 25% of pods ripe.
- Allow the pods to dry until brown on the vines
- Cut vines and keep for full drying.



Carrot

- Carrots spiny little seeds form an umbel on the top that eventually dries at which point the seed is ready to be harvested
- The dried umbels eventually break off
- Individual flower produces a pair of seeds



Cleaning and grading of seeds

- Done to remove undesirable materials from desired ones
- Undesirable materials include:
 - inert matter
 - weed seeds
 - other crop seeds
 - light-damaged or deteriorated seeds
- Home gardeners perform this process mainly by winnowing and by gravity separation using a bamboo winnowing tray.

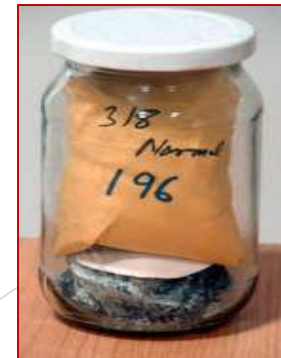


Best way to store seeds

- **Factors affecting seed viability in storage: moisture content and storage temperature**
- **Most vegetable seeds can be safely stored for at least three to five years.**
 - **Seeds will absorb moisture from the storage environment.**
 - **Seeds should be dry enough (seed moisture content around 7-8%) before storage, and kept in an air-tight container, such as screw-top jar.**

Storage Containers: Different containers used include:

- Paper and cloth bags – for short term storage.
- Metal, Polythene, Glass, Laminated and foil containers for moisture proof and long term storage
- If small quantities of many species and varieties are to be stored a home-made desiccator can be used.
- Desiccants: silica gel, calcium chloride, quick lime, cooled-down fresh wood ash, and dry charcoal.
- At the bottom of the jar, a layer of desiccant (e.g., silica gel), which is about 10% of the container space, is put. This is followed by a porous layer of paper, wire-mesh, or perforated metal plate as base for the seed packages to stand on.



Storage options



•Following these facts, a home gardener can save his own good quality seed and will be able to not only support his future home gardens, but can also help others establishing home gardens

•“Seed costs nothing but pays.....”

Emerging and Novel Home Gardening Technologies-Pathways to New options



M. L. Chadha
Former Director
AVRDC –The World Vegetable Center
Chairman
Madan Chadha Safe Healthy Vegetable Foundation

Hi-tech Interventions in Home Garden

1. A new way to grow vegetables, that is soil less system..... Known as HYDROPONICS



THE RESULTS OF HYDROPONICS

Land is unnecessary

No hazard from continuous cropping

Produce is chemical free

The growth period is shortened

A higher yield and better quality

Hydroponics: a method of growing plants using mineral nutrient solutions, without soil.



**A Non-circulating Hydroponic-system
for the small gardeners**

Setting up a Home Garden Hydroponic System





1. The first is a container for the nutrient solution. Almost any kind and any shape of the container can be used.

This one is styrofoam which holds the temperature of the nutrient solution nicely.



Table 1a. Constituents of Nutrient Solution*

Element	Chemical formula	Concentration (ppm)	Amount (g/l solution)
N	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	70.0	0.59
	KNO_3	30.0	0.22
P	K_2HPO_4	15.0	0.09
K	KNO_3	38.0	—
	K_2HPO_4	83.8	—
Ca	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	100.0	—
	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$	50.0	0.18
Mg	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	48.6	0.49

*Using 4 N H_2SO_4 to adjust the pH value to 6.0.

2. To begin the box for planting, fill it first about $\frac{3}{4}$ full of the nutrient solution



3. Then prepare the pots for planting. Place a piece of netting on the bottom of the pots. This helps prevent the seedling media from coming down and separating the root system. It also helps in the uptake of oxygen and the absorption of the nutrient solution.



4. Fill the pots about three fourth full of seedling medium

Smoked rice hull can be used. Ordinary rice hull is not effective as a seedling medium. Soil is not recommended either.

➤ If smoked rice hull is not available, vermiculite or similar types of seedling medium can be used.



It is also possible to plant large root plants such as onions or radishes. In this case you can use a net tray rather than pots.



5. Then place the pots into the perforated lid of the box



6. Check to make sure that the pots are placed so that the solution is 2-3 cm above the bottom of each pot.



7. Sow the seeds and cover lightly with more smoked rice hull



8. Remember to cover the box with the plastic netting to prevent insect invasion. When it is raining, cover it with plastic to keep out the rainwater.



9. Leave the plants to grow with little or no care



Leave the plants to grow with little or no care

Before too long, harvest the vegetables, and enjoy as they are healthy, and disease, insect, and chemical free.

And everybody benefits from that!!!



Basic requirements

1. Light

- In a hydroponic system sunlight is not always an option.
- Artificial horticultural lights provide the solution for the hydroponic gardener; these are cost effective too.

2. Oxygen-Nutrient ratio

- Oxygen maintains a healthy root system and allows the plant to absorb nutrients.
- In a hydroponic system, the water is a medium through which nutrients and oxygen are fed to the roots.
- Therefore, the roots should be kept moist, not soaked.

3. Growth mediums

- In hydroponics, the growing medium is composed of inert mineral matter, thus avoids soil-born problems.

4. pH- alkalinity and acidity

- Most nutrients in common tap water will be within the range of 6 to 6.5 pH, which is suitable for hydroponics systems.

5. Temperature

- The ideal temperature for growing vegetables is between 4° to 29°C (40-85°F)

6. Air

- Proper ventilation essential and recommended for a lush hydroponics vegetable garden as well.

7. Water quality

- Tap water is just fine for hydroponics systems.
- Excessive salinity or high zinc content could be harmful to the hydroponics garden



An upcoming modern home hydroponics system

Window Hydroponic: hydroponic growing system offers the ease of window farms.



Roof Hydroponic: the farm has moved to the city in the form of rooftop hydroponic leaving the dirt and pests and pesticides behind in the rural field.



Sprouting Technology

- ▶ Improving nutritional quality
- ▶ Rich in digestible protein (21-28%)
 - ▶ bioavailable vitamins (A, B, C, E)
 - ▶ minerals Fe, Ca, Zn, K
 - ▶ amino acids
- ▶ Have more enzymes and phytochemicals,
 - ▶ 100 times more than in fruit and vegetables
 - ▶ free from cholesterol



**One cup: 30 calories,
3 g protein,
6 g carbohydrates &
2 g fat.**



**Mungbean sprout
valuable for health and
agribusiness**

Sprout production box technology- **Low cost and easy way for home scale sprout production**



Sprout box



Parts



Seed cleaning & soaking



Transfer to box



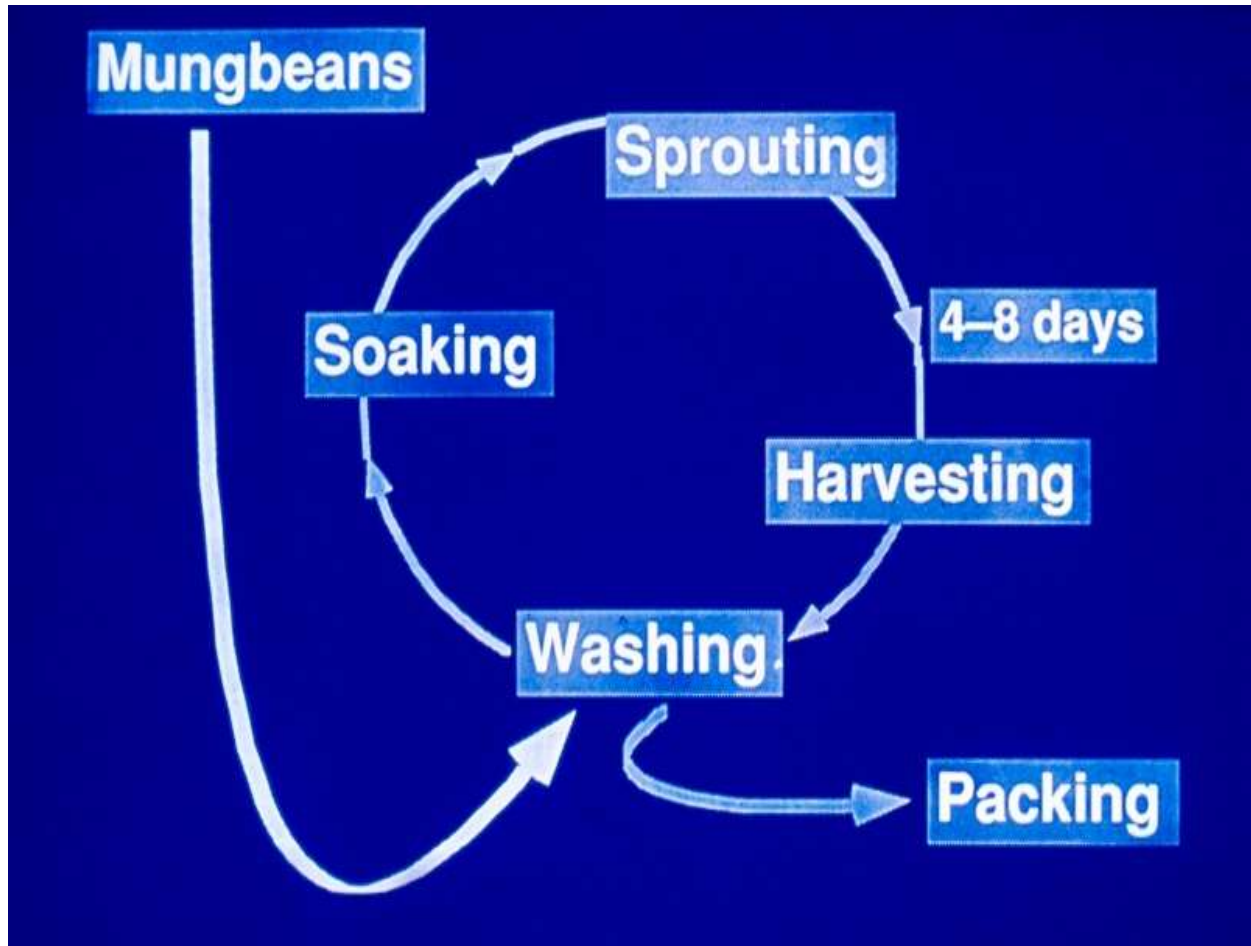
72 h after soaking

Temperature
23-28°C

Humidity
85-90%

Good quality crispy sprouts

IDEAL CONDITIONS for GOOD QUALITY SPROUTS



Mungbean Production – From soaking to harvesting to marketing

Mungbean Sprout Production – Homestead level



Day 1



Day 2



Day 3





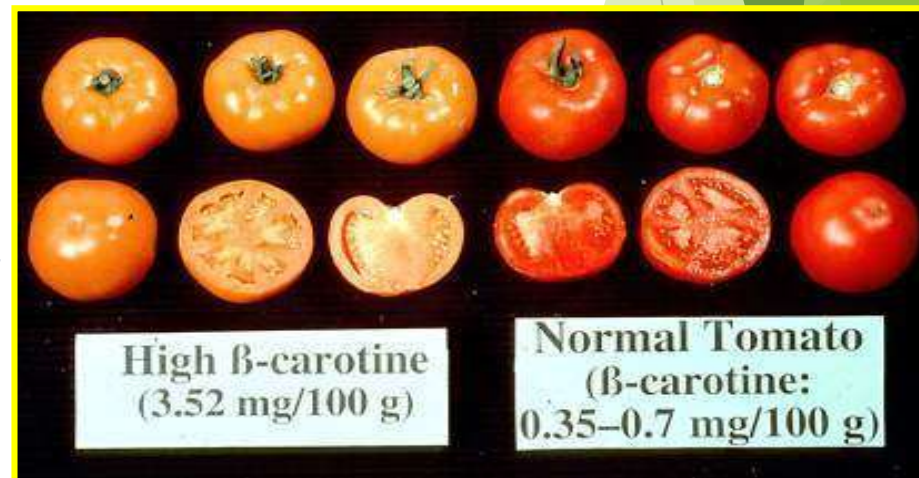
Mungbean Sprout harvest



Enjoy Mungbean Sprout recipes

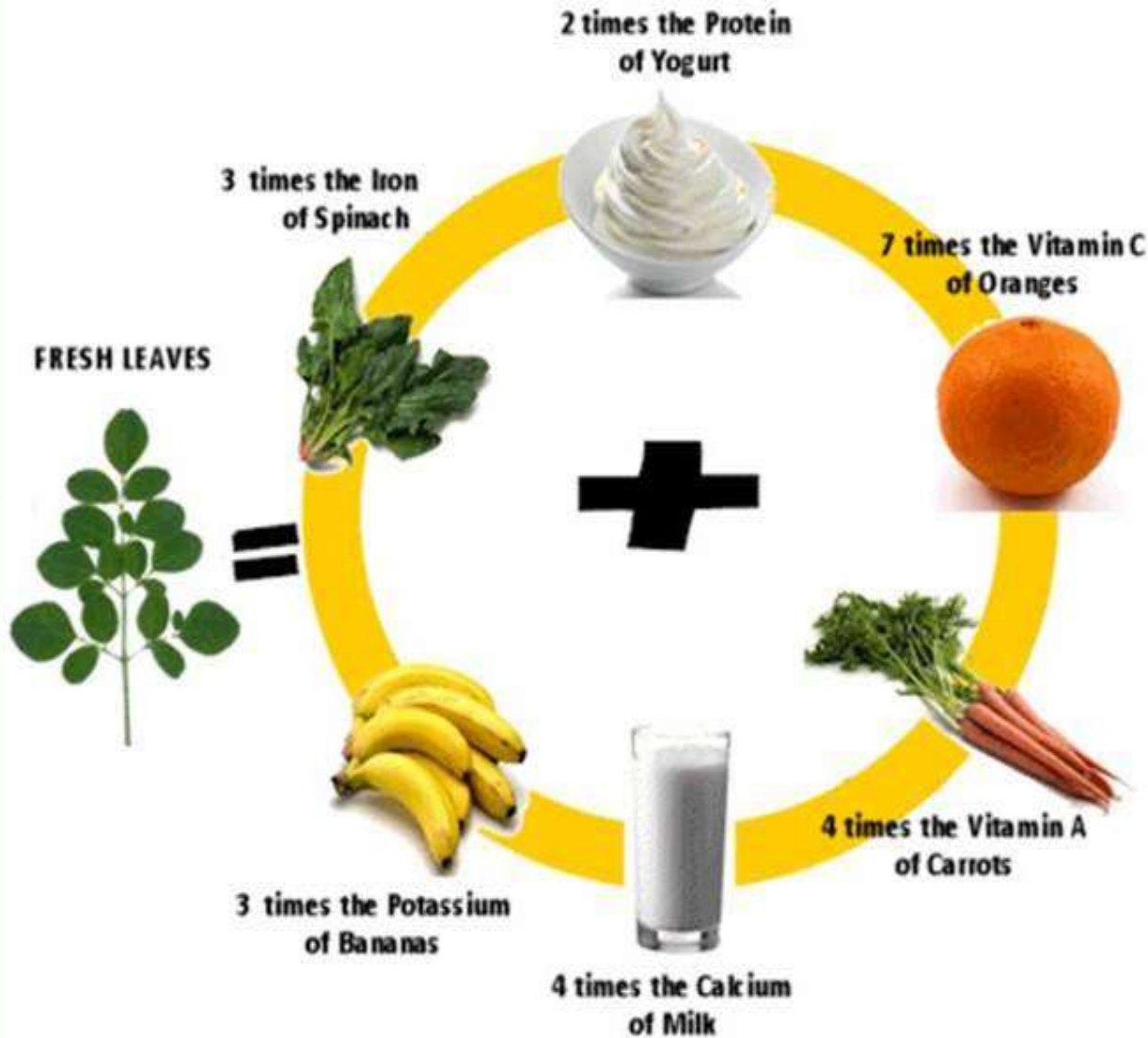
Bio-fortified vegetables

- ⇒ “Golden tomatoes” :
 - ❑ High quality
 - ❑ Nutritious
 - ❑ Good marketability
 - ❑ Resistance to multiple diseases
- ⇒ Contain 3 to 6 times more vitamin A than standard types
- ⇒ One single improved tomato can provide a person’s full daily vitamin A requirements



Moringa

One of the most nutritious crops showing great



Moringa leaves for processed products



Grafting technology

- Grafting of vegetables is a common practice to control soil borne diseases and nematodes, for both field and greenhouse crops.
- In addition, grafted vegetables can produce higher yields and have improved tolerance to environmental stresses, soil salinity, and low soil temperatures
- Grafting techniques for tomato and eggplant to reduce bacterial wilt incidence Under adverse conditions, grafted tomato plants produced yields that are 20-100% higher than non-grafted plants



(Cont.....)

6 AirPurifying House Plants



1. Bamboo Palm, 2. Snake Plant, 3. Areca Palm, 4. Spider plant, 5. Peace Lily and 6. Gerbera Daisy

- remove **formaldehyde** and act as a **natural humidifier**, for general air cleanliness, removing **carbon monoxide** and other **toxins or impurities**.

Nutrition: Points to Consider:

Fruits and vegetables provide many essential nutrients such as vitamins, minerals, fiber and other substances that are important for good health: The Nutrients in Fruits and Vegetables Help You Maintain:

- ▶ a healthy heart.
- ▶ a lower risk of certain types of cancers.
- ▶ vision and eye health.
- ▶ a strong immune system.
- ▶ memory and mental function.
- ▶ healthy teeth and gums.
- ▶ most fruits and vegetables are naturally low in fat and calories and are filling so they can help you avoid weight gain.

As we get older, it becomes more important that we consume enough of certain nutrients including the minerals calcium and potassium, the vitamins A and C, and fiber.

**Use a lot of colorful vegetables to make a salad.
Dress with low-fat salad dressing**



Nutrition

Vit.	Amount	Crops
Vit. A	>2000 IU	Amaranth, malabar spinach, kale, kangkong, lettuce, carrot
Vit. B	>17 mg	Legumes, taro, horseradish leaves
Vit. C	>20mg	Amaranth, malabar spinach, cabbage, kale, kangkong, bitter- gourd
Ca	>20 mg	Amaranth, spinach, cabbage, kale, kangkong, lettuce, mustard, breans, onion, turnip, soybean
Fe	>3mg	Amaranth, spinach, kangkong, lettuce, chillies
P		Spinach, beans, lettuce, onion, tomatoes, cabbage, broccoli cauliflower,
Iodine		Onion, okra, asparagus

Nutrition: Multi-nutritional vegetables

Crops	Vitamins & Minerals
Amaranth	Vit, A, C, Ca, Fe
Malabar spinach/ spinach	Vit, A, C, Ca, P
Kangkong	Vit, A,C, Ca, Fe
Pepper	Vit. A, C, E
Pumpkin	Vit. A, Carbohydrate
Leafy crucifers	Vit. A, C, folate, minerals
Vegetable soybean	Vitamins, protein, isoflavon, fat free from cholesterol
Broccoli	Vit A, C, minerals

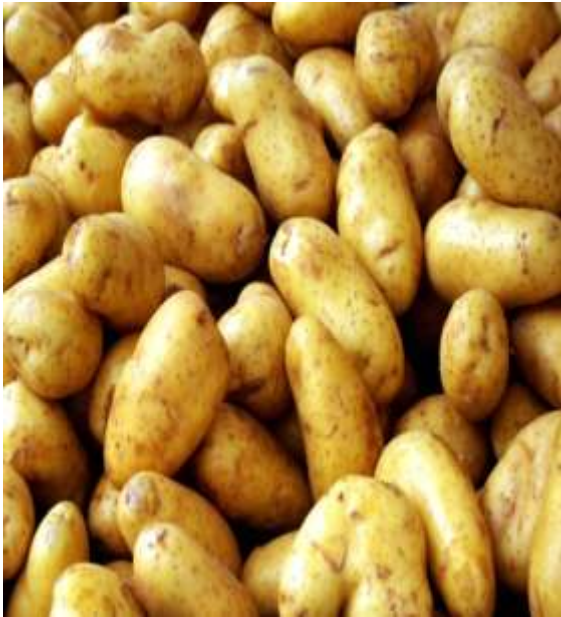
Calcium:

- ▶ maintains strong bones and teeth.
- ▶ helps muscles and blood vessels contract and expand.
- ▶ helps to send messages through the nervous system.
- ▶ is essential for blood clotting.



Potassium:

- ▶ may lower blood pressure.
- ▶ may reduce the risk of developing kidney stones.
- ▶ helps to decrease bone loss.



Vitamin A:

- ▶ keeps eyes and skin healthy.
- ▶ helps to protect against infections.



Vitamin C:

- helps heal cuts and wounds.
- keeps teeth and gums healthy.
- helps you absorb iron.



Fiber:

- ▶ when consumed with adequate fluid helps prevent constipation and maintain bowel health.
- ▶ helps to maintain a healthy weight.
- ▶ may help lower your risk of diabetes and heart disease.
- ▶ To get the most fiber from your fruits and vegetables, whenever possible.



Fruits and Vegetables are also Good Sources of Phytochemicals

What the heck are Phytochemicals??

- ▶ are substances in plant foods that are not essential nutrients like vitamins and minerals, but they may have health-promoting properties.
- ▶ may help reduce the risk of heart disease and certain types of cancer.



Phytochemicals

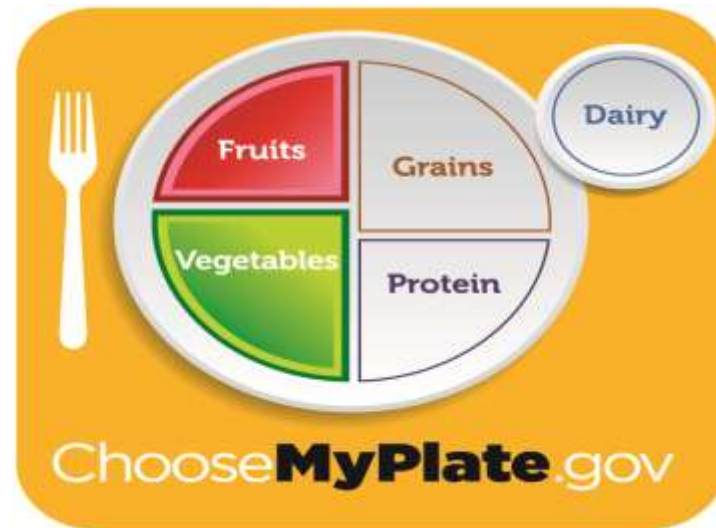
- ▶ **Some are responsible for the flavor, aroma and color of fruits and vegetables.**
- ▶ **So, include a rainbow of color in your diet in the form of a variety of fruits and vegetables to get an abundance of phytochemicals.**



How many servings of fruits and vegetables are recommended?

- ▶ 1½ to 2 cups of fruit per day
- ▶ 2 to 2½ cups of vegetables per day

Make Half Your Plate Fruits and Vegetables



There are so many ways to eat **Fruits & Vegetables** every day.

Menace of Pesticide use : Effects above their permissible limits















Possible Ailments

- ▶ -Nervous system related problems
- ▶ -Endocrine disruption
- ▶ -Liver disfunction
- ▶ -Convulsion
- ▶ -Cancer
- ▶ -Enzyme inhibition
- ▶ -Kidney malfunction

Our plates loaded with pesticides: Survey

WATCH WHAT YOU EAT

Figures reflect how common food items contain banned pesticides in quantities way above their permissible limits

<p>■ BRINJAL  >> HEPTACHLOR</p>  <p>0.48 860</p>
<p>■ CABBAGE  >> CYPERMETHRIN</p>  <p>3.91 95.5</p>
<p>■ OKRA  >> CYPERMETHRIN</p>  <p>0.31 55</p>
<p>■ RICE  >> CHLORFENVINFOS</p>  <p>0.36 1324</p>
<p>■ BANANA  >> CHLORODANE</p>  <p>0.15 54</p>
<p>■ CAULIFLOWER  >> ALDRIN</p>  <p>0.42 320</p>
<p>■ APPLE  >> DICHLORVAS</p>  <p>0.24 140</p>

Source: Union agriculture ministry

■ ITEM	● CONTENT: (part per million)
 CHEMICAL DETECTED	
	% ABOVE LEGAL LIMITS

POSSIBLE AILMENTS

- Nervous system-related problems
- Endocrine disruption
- Liver dysfunction
- Convulsion
- Cancer
- Enzyme inhibition
- Kidney malfunction

DO YOUR BIT

- 1 Wash the fruit and vegetables in running water four or five times
- 2 Soak them in salt water for a few minutes. This will help kill germs
- 3 Wash them with **potassium permanganate solution** and wash again with fresh water before consuming them
- 4 Peel skin off fruit and vegetables whenever possible. Even if you plan to remove the skin from fruit and veggies, wash them first to eliminate pesticide residue
- 5 Buy **organic** fruit and vegetables if possible. Smaller the veggie is in size, more organic it is

REALITY CHECK

“ There is hardly any surveillance of residue pesticide levels in food products other than the one run by the ministry of agriculture

Kavitha Kuruganti | ALLIANCE FOR SUSTAINABLE & HOLISTIC AGRICULTURE

The SC in its October 22 order has said that the Food Safety and Standards Authority of India should be made responsible for monitoring and exercising control on soft drinks. The problem is not only with vegetables

Amit Khurana | CENTRE FOR SCIENCE AND ENVIRONMENT





Wax.... Free..... ??????

Home Gardening Food Safety: Washing the Fruits and vegetables

► To reduce the chance of getting sick from foodborne illnesses, one must wash the fruits and vegetables you grow before eating them raw or cooked.



Good Food Safety Practices

- ▶ **Preparing fresh produce**
 - ▶ Before and after preparing fresh produce, wash your hands for 20 seconds with warm water and soap.
- ▶ **After harvesting, it is time to clean them.**
- ▶ **Make sure that the area for handling fruits and vegetables is clean, including the kitchen counter and any kitchenware that may be used.**
- ▶ **Water is the leading option when washing produce.**



4.

- ▶ It is well established that white distilled vinegar, lemon juice and apple cider vinegar can be slightly more effective than just plain tap water for washing homegrown produce, especially leafy greens in salad and floral greens such as broccoli, cauliflower.
- ▶ To make a vinegar solution at home, mix $\frac{1}{2}$ cup of white distilled vinegar with 2 cups of water. Spray the vegetables with this solution or dip them in it and then re-rinse the produce under clean water. There is a chance that using these alternatives may affect taste and texture.

Good Food Safety Practices

▶ Storing fresh produce

- ▶ Store most fruits and vegetables in a clean refrigerator at 40 degrees or below in a perforated bag to help maintain quality.
- ▶ Make your own perforated bags by making several small holes in a food-grade plastic bag with a sharp object.



Good Food Safety Practices

Preparing fresh produce

- ▶ **Remove the outer layers of leafy produce before washing; the outer leaves can conceal bacteria because they come into contact with more pathogens.**



- ▶ For produce with thick skin, such as melons, use a vegetable brush when washing.



Good Food Safety Practices

▶ Preparing fresh produce

- ▶ Produce with a lot of nooks and crannies like cauliflower, broccoli or lettuce should be soaked for 1 to 2 minutes in cold clean water.



It's True....

Fruits & Veggies are
Nutritious AND
Delicious!

Grow more and more safe and
healthy vegetables and fruits.....

Thank you...from MCSHVF : Your partner in

awareness against pesticides residues /abuse effecting consumers health, Encouraging safe and healthy vegetable production through Home/kitchen /school/market gardening .



Safe Healthy Vegetable Foundation (MCSHVF)

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