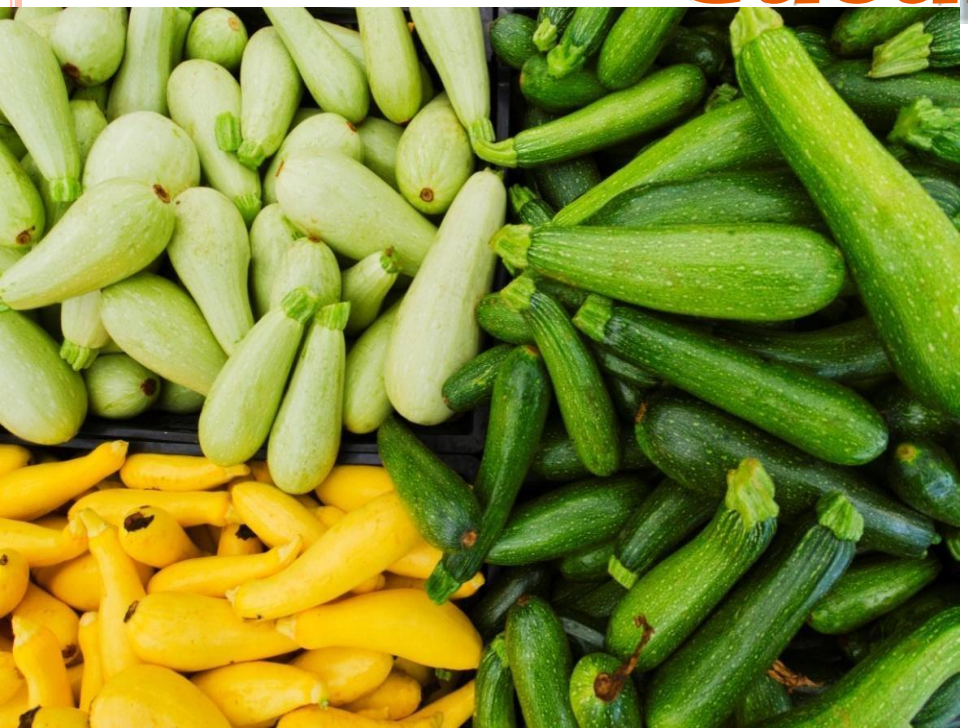
WELCOME

Advances in Production and Breeding of Important Cucurbits



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TAXONOMIC POSITIONS

KINGDOM: Plantae
PHYLLUM: Angiosperms
DIVISION: Magnoliophyta
CLASS: Magnoliopsida
ORDER: Cucurbitales
FAMILY: Cucurbitaceae

Common name	**Botanical name**	**2n chromosome no.**
Muskmelon	*Cucumis melo* L.	24
Cucumber	*Cucumis sativus* L.	14
Watermelon	*Citrullus lanatus* Thunb.	22
Bottle gourd	*Lagenaria siceraria* (Mol.) Standl.	22
Bitter gourd	*Momordica charantia* L.	22
Pumpkin	*Cucurbita moschata* Duch. Ex Poir.	40
Summer squash	*Cucurbita pepo* L.	40
Winter squash	*Cucurbita maxima* L.	40

Origin

Crop	Origin
Muskmelon	Western Africa
Cucumber	Himalayan foothills (India)
Watermelon	Central and South Africa
Bottle gourd	Tropical Africa
Bitter gourd	South Asia (Eastern India and Southern China)
Pumpkin and squashes	Mexico and South America

Muskmelon

Cucumber

Watermelon

Bottle gourd

Bitter gourd

Pumpkin and squashes

INTRODUCTION

Cucurbits are the largest group of summer vegetable grown almost in all states of the country

These belong to family Cucurbitaceae, comprising of 120 genera and about 800 species

(Rubatazky and Yamaguchi, 1999)

AREA AND PRODUCTION OF MAJOR CUCURBITS IN INDIA

Crop	Area ('000 ha)	Production (' 000 MT)	Productivity (t/ha)
Muskmelon	36.70	760.81	20.73
Cucumber	43.28	678.15	15.67
Watermelon	74.64	1809.83	24.25
Bottle gourd	103.23	1818.86	17.62
Bitter gourd	78.89	807.47	10.24
Pumpkin	19.76	416.11	21.06

NHB Database, 2014

MEDICINAL VALUE

Crop	Medicinal properties
Muskmelon	Cures chronic eczema, diuretic and aphrodisiac
Cucumber	Cooling effects on body, diuretic, lowers blood sugar and prevents constipation
Watermelon	Diuretic, purgative, cooling effect on body and aphrodisiac
Bottle gourd	Purgative, prevents jaundice and application for burns
Bitter gourd	Antihelmintic, anti septic, lowers down blood sugar and antidote to snake poison
Pumpkin	Antihelmintic, diuretic and effective against nervous disorders

Seshadri and More, 2009

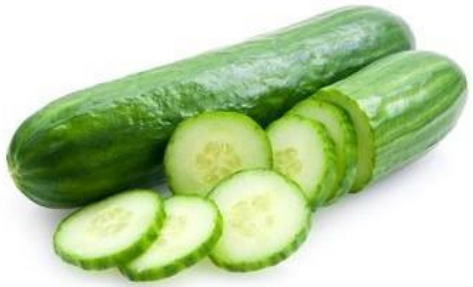
NUTRITIONAL COMPOSITION (per 100 g edible portion)

	Energy (kcal)	Carbo-hydrate(g)	Protein (g)	Carotene (mg)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
Muskmelon	17	3.5	0.2	**169**	**32**	14	1.4
Cucumber	13	2.5	0.4	7	10	25	1.5
Watermelon	**26**	**6.4**	0.5	----	7	10	0.5
Bottle gourd	12	2.5	0.2	----	----	10	0.7
Bitter gourd	25	4.2	**1.6**	126	20	**70**	**1.8**
Pumpkin	25	4.6	1.4	50	20	30	0.7

Hazra and Som, 2014

ECONOMICAL USES

- **Fruits:**
  - ✓Salad: Cucumber and Long melon
  - ✓Cooked: All gourds and chow chow
  - ✓Dessert fruit: Muskmelon and Watermelon
  - ✓Pickle: Cucumber and Gherkin
  - ✓Sweets: Ash gourd and Bottle gourd
- **Leaves:**
  - ✓ Cooked vegetable: Bottle gourd and Pumpkin (East and South India)
- **Flowers:**
  - ✓ Fried: Pumpkin
- Dried shell of bottle gourd: Novelty container, bottle, musical instruments

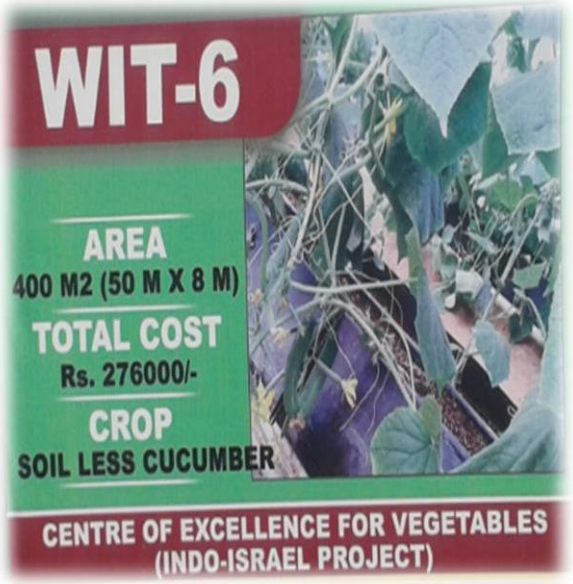


Advances in production technologies

- Soil
- Climate
- Time of planting
- Propagation and nursery raising
- Propagation through stem cuttings
- Grafting
- Training
- Pruning
- Pollination
- Nutrient management
- Irrigation management
- Mulching
- Protected cultivation
- Production in low poly tunnels
- Harvesting indices
- Harvesting and storage
- Plant protection measures
- Seed production

Soil

- Well drained loamy soil is preferred for all cucurbits
- Grown in **light soil where earliness is prerequisite**
- **In heavy soils fruits mature late** due to heavy initial vegetative growth
- Sandy soil, supplied with organic matter is also suitable (riverbed cultivation)
- Majority of cucurbits thrive best around soil **pH 6.5-7.0**
- Watermelon can be grown in pH around 5.0
- Soil less culture can also be followed with growing media like **perlite, vermiculite, sawdust, rock wool** or mixture of these



Climate

- Warm season vegetables
- Susceptible to frost
- Photo insensitive for flowering
- Photoperiod affects sex expression

Warm dry	**Warm humid**	**Low warm humid**
30-35^0 C	25-30^0 C	<25^0 C
< 50% RH	50-65% RH	>65% RH
Watermelon	Bitter gourd	Ivy gourd
Muskmelon	Bottle gourd	Chow chow
Pumpkin	Sponge gourd	Pointed gourd
Squashes	Ash gourd	

- Cucumber requires relatively cooler humid climate falls between warm dry and warm humid
- Accordingly planting time is adjusted keeping in view the climatic requirements of the crops

TIME OF PLANTING

Watermelon and Muskmelon:

- February-March (spring summer crop)
- October-November in North India with frost protection in poly-house or poly-tunnels
- Planting is adjusted in such a way that maturation phase coincides with rain free day with ample sunshine and cooler nights

Bitter gourd and bottle gourd:

- February-March (spring summer crop)
- June-July (rainy season crop)
- October- November sowing is only followed for riverbed cultivation

Cucumber:

- February-March in plains (spring summer crop)
- May-July in hills (rainy season crop)

Pumpkin and Squashes:

- February- March (spring summer crop)
- October-November with frost protection (to catch early market)

PROPAGATION AND NURSERY RAISING TECHNIQUES

- ✓ Monoecious annual cucurbits: Seeds
- ✓ Monoecious perennial (chow chow): Sprouted fruits
- ✓ Dioecious perennial: Vegetative means (vine cuttings) during October- November when plants go under dormancy

Nursery raising in plug trays (50 celled) permits early production and lowers the seed rate

Coco peat, vermiculite and perlite @ 3:1:1 (v/v/v) ratio is recommended for cucurbits (Singh, 2012)

CUCUMBER PROPAGATION THROUGH VINE CUTTING

Why to go for stem cutting?

- Produces disease free, uniform and elite propagules
- Produce early flowers and same yield as seedling
- Form a single plant, several cuttings can be produced

8-10 cm long tender and succulent cuttings are taken

Retain 1 set of true leaves and cut the others off

Give a slanting cut below a node with sharp blade

Plant in a media containing Cocopeat: perlite: vermiculite

Keep at around 25 ^{0}C and 80% RH

Water with sprinkler twice a day

In 14 days, cuttings become ready for transplanting

Kumar *et al.* 2015.
Indian Horticulture
July- August: 19-20

GRAFTING

This is a mode of propagation where a desired shoot (scion) is placed and allowed to unite on another plant (rootstock)

Commercial vegetable grafting is followed in Japan, Korea, Phillipines, Grece, USA etc.

Advantages of grafting in cucurbits (Hazra and Som, 2014):

- ✓ Changes the sex expression when grafted on different rootstocks having differential sensitivity to endogenous ethylene production
- ✓ Avoids soil borne diseases (*Fusarium* wilt in cucumber, watermelon, muskmelon and bitter gourd) on *Cucurbita ficifolia*
- ✓ Avoidance of nematode infestation on rootstock *Sicyos angulatus*
- ✓ Avoidance of auto toxicity that affects ion uptake, membrane permeability, photosynthesis and phytohormone balance in cucumber, muskmelon and watermelon
- ✓ Provides cold hardiness, ensure early growth and yield in cucumber on *Cucurbita ficifolia* which enables survival at 20^0 C/12^0 C day/night temperature

PROMISING ROOTSTOCKS

Crop	Rootstocks
Muskmelon (open field)	*Cucurbita moschata*, *C. moschata x C. maxima*
Muskmelon (protected)	*Benincasa hispida*, *C. moschata x C. maxima*
Cucumber	*Cucurbita moschata*, *C. ficifolia*, *C. maxima*, *Sicyos angulatus*, *Lagenaria siceraria*
Watermelon	*C. moschata x C. maxima*, *Lagenaria siceraria*, *Citrullus* sp.
Bitter gourd	*Luffa aegyptica*, *Cucurbita moschata*, *Laginaria siceraria*

(Hazra and Som, 2014)

TRAINING

- Training is very essential due to their viney nature (except summer squash)
- Watermelon and muskmelon are generally not trained owing to their lager fruit size
- In homestead farming, these are trailed on thatched huts or walls

Training systems

- Bower system

Bower system of training gave significantly higher yield and less fruit damage in bottle gourd cv. Samrat under Rahuri condition

(Thamburaj and Singh, 2014)

- Kniffin system

Ridge gourd and sponge gourd are commercially trained on kniffin system

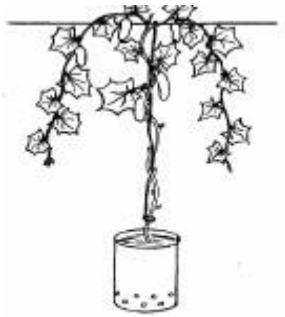
(Thamburaj and Singh, 2014)

Tropical Agricultural Research Vol. 18: 346 - 357 (2006)

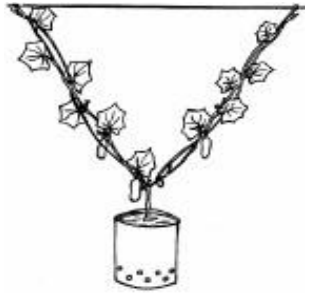
Plant Training and Spatial Arrangement for Yield Improvements in Greenhouse Cucumber (*Cucumis sativus* L.) Varieties

M.G.S. Premalatha[1], K.B. Wahundeniya[2], W.A.P. Weerakkody[1] and C.K. Wicramathunga[2]

Three training systems viz. **Umbrella** system at spacing of 60 cm × 60 cm, **V system** at 60 cm × 60 cm and **coiling** of stem around growing bag at 45 cm × 45 cm were carried out in three varieties Thunder, Sakura and Efadal in Srilanka.



Umbrella system



V – System

New system

RESULTS

- Umbrella system recorded highest fruits : flower ratio (0.5) as compared to other two (0.33) and highest per plant yield (2.82 kg)
- Both umbrella and V system showed higher ratio of fertile node to total node (0.40) as compared to other new system (0.25)
- New system recorded highest LAI, highest total yield (9.75 kg per m^2) and highest marketable yield (9.2 kg per m^2)
- They concluded that highest total and marketable yield per unit area was attributed to the more plant density
- Therefore the new system i.e. coiling the stem around growing bag may be followed in cucumber

PRUNING

- Whenever the plants are trained in any systems, side shoots are pruned until vine reaches the top
- When the vines reach top of the system, prune the main vine to promote axillary branches
- Pruning gives **higher TSS**, **ascorbic acid**, **reducing sugar** and **better pulp thickness** in muskmelon and watermelon (Thamburaj and Singh, 2014)
- Pruning promotes more lateral branches and has positive significant correlation with yield as this narrow down the male : female sex ratio by auxin translocation in cucumber

World Journal of Agricultural Sciences 9 (3): 220-226, 2013
ISSN 1817-3047

DOI: 10.5829/idosi.wjas.2013.9.3.1728

Phytohormones Content in Cucumber Leaves by Using Pruning as a Mechanical Stress

[1]Hidayatullah, [2]Asghari Bano and [1]Mansab Ali Khokhar

Studied the effect of mechanical stress caused by pruning of lateral branches on yield and sex expression of cucumber cv. Shialkot Selection in Pakistan

Treatment code	Treatment
T_0	Un-pruned plants
T_1	Main stem without any laterals
T_2	Main stem + 1 laterals
T_3	Main stem + 2 laterals
T_4	Main stem + 3 laterals
T_5	Main stem + 4 laterals
T_6	Main stem + 5 laterals

RESULTS

- T_4 recorded greatest increase in female flower production, lowest male : female sex ratio, highest number of fruits per plant and highest yield as compared to control
- It was attributed to increase in IAA level and decrease in GA level at flower initiation, blooming and fruiting stages

It was concluded that mechanical stress by pruning treatment of main stem with 3 laterals (T_4) was best for higher yield in cucumber

POLLINATION

- Pollination in cucurbits is of utmost importance as they are multi seeded (except chow-chow)
- One or more pollens are necessary for a single seed development
- Improper pollination leads to poor fruit set and crook necked unmarketable fruits that ultimately results in poor yield
- Cucurbits are cross pollinated and entomophillus
- Major pollinating agents are honey bees and beetles like *Conpophilus* sp. and moths like *Pygargonia* sp. and *Planidia* sp.

50 YEARS WITH IMPACT Journal of Applied Ecology British Ecological Society

Journal of Applied Ecology 2015, 52, 261–269 doi: 10.1111/1365-2664.12357

Pollination mitigates cucumber yield gaps more than pesticide and fertilizer use in tropical smallholder gardens

Iris Motzke[1,2*], Teja Tscharntke[1], Thomas C. Wanger[3,4] and Alexandra-Maria Klein[2,3]

The study was conducted in 13 traditional home gardens of Indonesia

Treatments

- Weed control v/s no weed control
- Fertilizer application v/s no fertilizer
- Herbivore control v/s no herbivore control

Each of the 3 treatments were combined wind pollination in cage v/s open insect pollination

Results:

- ✓ Strongest negative effect on fruit set was caused by exclusion of insect pollinators (86%) followed by no weed control (20%)
- ✓ No fertilizer application and herbivore control did not significantly reduce fruit set
- ✓ Recorded yield reduction of 75% in wind pollination, 45% in no weed control and 18% in no fertilizer application
- ✓ Operational cost exceeded the net income when pollinators were excluded
- ✓ Net income was highest in treatment insect pollination, with weed control and fertilizer application

Although positive effect of ferltizer application and weed control was recorded on yield, that could not compensate negative effects of absence of pollinators

STRATEGIES FOR IMPROVING POLLINATION

- Adjust the planting time in such a way that fruiting is over till April or starts after July
- Keep at least two bee hives per hectare when 25% plants have flowering
- In dioecious crops, keep at least 10% pollen parent scattered in the field for effective pollination
- In dioecious crops hand pollination in early morning is practiced for better fruit set
- In bottle gourd and ridge gourd flower open in afternoon when natural bee activity is very low, placement of bee hives is of at most importance

Nutrient Management

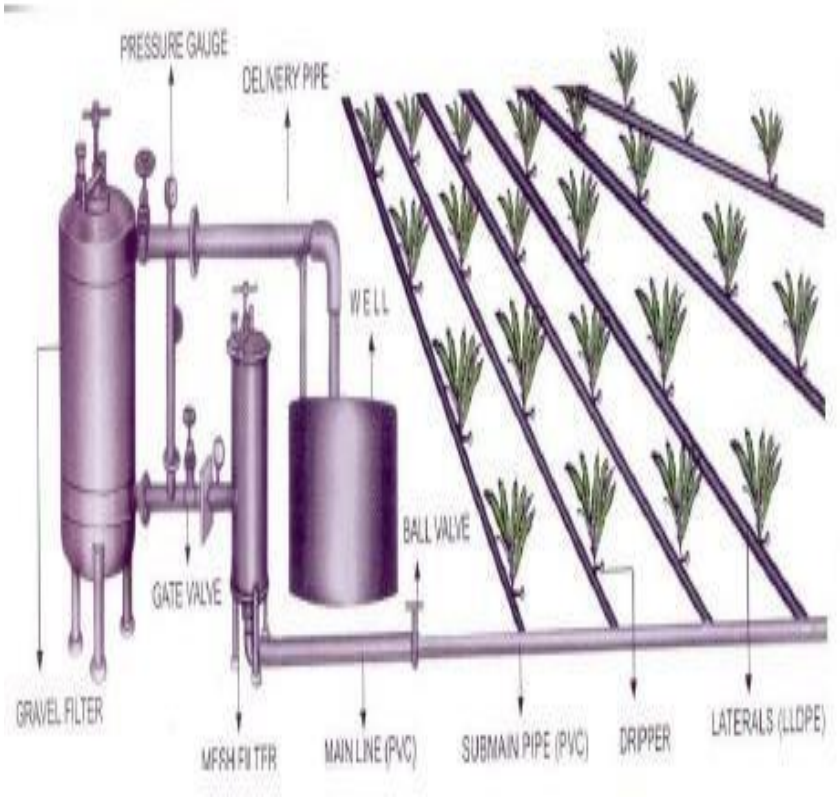
Crop	FYM (t/ha)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potassium (kg/ha)
Muskmelon	25-30	125	70	70
Cucumber	15-20	100	60	60
Watermelon	15-20	100	60	70
Bitter gourd	20-25	100	60	50
Bottle gourd	15-20	100	60	60
Pumpkin	20-25	100	60	60

- Fertigation can be followed for better growth and fruit production in cucumber
- Top dressing of nitrogenous fertilizer should be completed before the commencement of fruit set
- Higher doses of potassium in muskmelon and watermelon increases TSS

(Thamburaj and Singh, 2014)

IRRIGATION MANAGEMENT

- Flowering and fruit set stages are the most critical stages for irrigation
- Moisture stress during flowering induces maleness
- In watermelon and muskmelon, when fruits reach maturity, frequency of irrigation is reduced
- In arid zones, pitcher irrigation is practiced to increase water use efficiency in muskmelon and watermelon
- Riverbed crops requires less irrigations due to presence of high water table
- Soil moisture should always remain 10-15% above permanent wilting point
- Drip irrigation with fertigation is also recommended



Drip irrigation system

Agricultural Water Management 163 (2016) 169–179

Contents lists available at ScienceDirect

Agricultural Water Management

journal homepage: www.elsevier.com/locate/agwat

Attenuating the negative effects of irrigation with saline water on cucumber (*Cucumis sativus* L.) by application of straw biological-reactor

Yune Cao[a,b,*,1], Yongqiang Tian[a,1], Lihong Gao[a], Qingyun Chen[a,*]

Conducted experiment to study the effect of straw biological reactor (SBR) application on soil properties at main root zone (0-40 cm), plant growth, fruit yield and quality under saline water irrigation in **China**

Treatment code	Treatment
T_0	Untreated soil (C)
T_1	Irrigated with saline water (SW)
T_2	Treated with SBR and irrigated with saline water (SW + SBR)

T_1 recorded significantly higher salinity, higher pH in the main root zone of plants and significantly lowered the TSS, titratable acidity, vitamin C, biomass production and yield

T_2 recorded significantly lower salinity, lower pH at the main root zone of plants and significantly higher TSS, titrable acidity, vitamin C, biomass production and yield

- ✓ Negative effects of saline water on fruit quality were reduced by SBR application
- ✓ Application of SBR can be done to enhance plant growth and fruit quality under saline water irrigation

MULCHING

- Covering of the plant root zone with either organic or synthetic materials
- Among organic, grass, straw, paddy husk, saw dust are used
- Among synthetics, black polythene, transparent polythene and degradable plastic mulches are used

Added advantages:

- ✓ More advantageous in crops which are generally trailed on ground. For example Watermelon and Muskmelon.
- ✓ Reduces fruit decay by preventing direct contact with soil
- ✓ Reduces fruit fly attack on crops by checking their pupation
- ✓ Organic mulches add organic matter to soil upon decomposition

Polythene mulch in summer squash

Straw mulch in summer squash

Agricultural Water Management 128 (2013) 149–157

Contents lists available at ScienceDirect

Agricultural Water Management

journal homepage: www.elsevier.com/locate/agwat

Cucumber (*Cucumis sativus*, L.) water use efficiency (WUE) under plastic mulch and drip irrigation

T. Yaghi[a,*], A. Arslan[a], F. Naoum[b]

Studied the effect of two plastic mulch with drip irrigation on cucumber yield in Syria

Treatment code	Treatments	Yield (t/ha)	WUE (t/ha/mm)
T_1	Transparent mulch + drip irrigation (TM + DI)	63.9	0.262
T_2	Black mulch + drip irrigation (BM + DI)	59.7	0.238
T_3	Drip irrigation without mulching (DI)	44.1	0.153
T_4	Surface furrow irrigation (SI)	37.7	0.056

T_1 recorded highest soil temperature as compared to T_2

T_1 gave highest vegetative growth and almost double yield as compared to T_4

T_2 was best for weed control

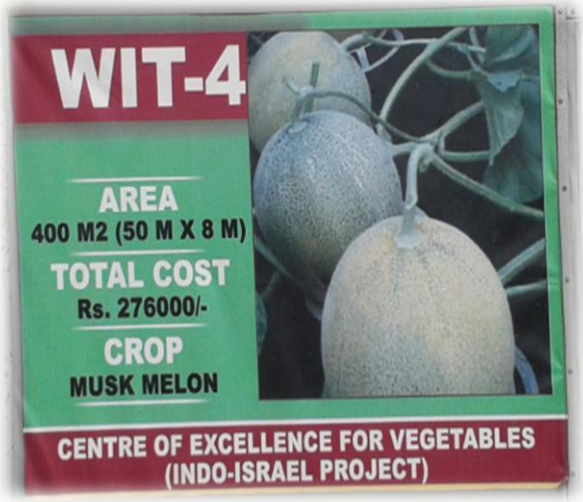
PROTECTED CULTIVATION

Principle involved:

- ✓ Absorbance of short wavelength of light and allow only PAR through the cladding material
- ✓ Short wave light (heat) penetrate into structures and structures in turn emit long wave length heat that fail to escape. It results into increase in temperature (Greenhouse effect)
- ✓ Greenhouse effect favours warm season crops during winter season
- ✓ During summer season cooling systems are used to lower down the temperature

Varieties:

- ✓ Cucumber:„NUN-9729“, „NUN-3019“, „Hilton“, „Pant Parthenocarpic Kheera-1“ and „Kian“
- ✓ Musk Melon: „Arava“ (Israel Hybrid)



CUCURBIT PRODUCTION IN LOW POLY TUNNELS IN ARID ZONE

- Dig trenches of 45-60 cm wide and 45-60 cm deep at a distance of 2-2.5 m in East West direction in December end
- Add recommended dose of manures and NPK to the trenches and mix thoroughly
- Place a drip lateral in each trench with discharge of 4l/hour/dripper spaced at 60 cm
- Soak the seeds 24 hours prior to sowing. Must be sown within 1st week of January. Irrigate the trenches after sowing.
- Fix flexible 2 mm iron hoops manually keeping 1 m width and 60-75 cm height from ground. Cover the structure with 30 -50 micron biodegradable plastic sheet
- Operate drip at 2-3 days interval for 1-1.5 hours
- Open the Eastern side during day for effective pollination by honey bees when the plants start producing pistillate flowers
- Plastic sheet is removed on second or third week of February when the outside temperature rises.

Choudhary *et al.* 2015.
Indian Horticulture, May –June: 22-24

Advantages:

✓Protection from frost

✓Earliness by 38-40 days

✓Provides early quality produce fetches high price in market

HARVEST INDICES

1. **Muskmelon:**
   - ✓ Half slip stage-for long distance transport
   - ✓ Full slip stage-For local market
   - ✓ Netting in cantaloupe
2. **Cucumber:**
   - ✓ Fruits of desirable size, having green skin colour
3. **Watermelon**
   - ✓ Dull sound upon thumping of fruits
   - ✓ Tendrils at fruit axil dry out and flower scar dry at the blossom end
   - ✓ Ground spot turns yellow
4. **Bottle gourd:**
   - ✓ Presence of little pubescence on fruit skin
5. **Bitter gourd:**
   - ✓ Appropriate size of fruits having either dark green, light green or white colour (depending upon the variety)
6. **Pumpkin:**
   - ✓ Harvested at both tender and mature stage
   - ✓ Harvesting at mature stage improves transportability and storage

HARVESTING, YIELD AND STORAGE

Crop	Days after sowing	Days after anthesis	Yield (q/ha)	Storage		
				Temperature (°C)	RH (%)	Storage life (days)
Muskmelon	90-125	30-35	100-150	5	95	10-12
Cucumber	60-70	7-9	150-200	10	85	10-14
Watermelon	95-120	40-45	200-250	13-16	80	14-21
Bottle gourd	60-65	12-15	**250-300**	8-10	85-90	14-21
Bitter gourd	60-70	10-12	100-150	0.6-1.7	85-90	28
Pumpkin	75-180	35-65	200-250	10-12	70-75	180

PLANT PROTECTION

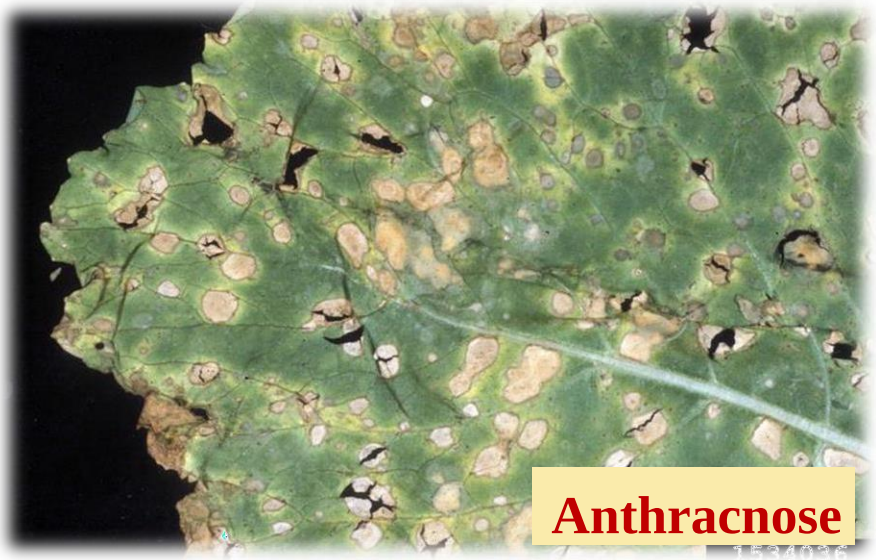
Fungal diseases

Diseases	Symptoms	Management
Powdery mildew (*Sphaerothica fuliginea)*	Nearly white or fluffy, somewhat circular patches on leaves. Leaves become yellow and fall off	Spray the crop with Karathane (0.05%) alternately with Thiophenate M (0.05%) at 7-10 days interval
Downy mildew (*Pseudopernospora cubensis*)	Downy purplish growth appears on the lower leaf surface during morning hours. Corresponding upper surface become yellow	Spray the crop with Mancozeb (0.25%) alternately with Ridomil MZ (0.15%) at 9-10 days interval

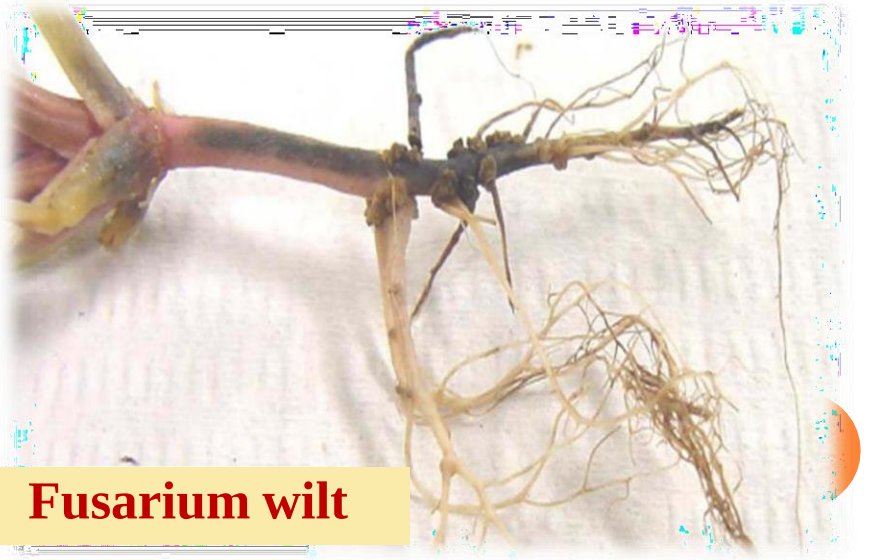
Powdery mildew

Downy mildew

Diseases	Symptoms	Management
Anthracnose (*Colletotrichum lagenarium*)	Reddish brown spots appear on leaves, petioles, stem and fruits. Fruits become shrivelled when pedicel is infected	Spray the crop with Bavistin (0.1%) or Thiophenate M (0.05%) at 5-7 days interval
Fusarium wilt (*Fusarium oxysorum f. niveum*) and (*F. o. f. melonis*)	It causes pre emmergence damping off, wilting in grown plants. Vascular bundles of affected plants show browning	Drench the soil with Captan or Hexocap (0.2-0.3%) Hot water seed treatment at 55^{o}C for 5 minutes Follow crop rotation with rice



Anthracnose



Fusarium wilt

BACTERIAL DISEASES

Disease	Symptoms	Management
Angular leaf spot (*Pseudomonas syringae* pv. *lachrymans*)	Water soaked angular spots appear on leaves. Later the spots dry and fall off giving a „shot hole" symptom	Destroy all affected plant parts Avoid heavy and sprinkler irrigation Use disease free seed Spray the crop with streptomycin (400 ppm) or Bordeaux mixture
Bacterial leaf spot (*Xanthomonas campestris* pv. *cucurbitae*)	Very small water soaked spots appear on lower leaf surface and corresponding upper surface shows browning with yellow halo	

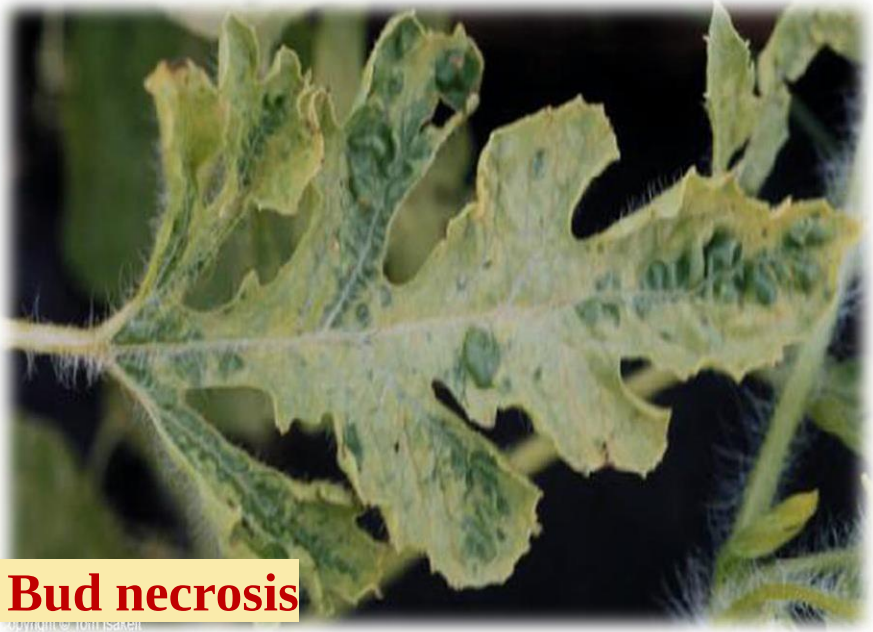
Angular leaf spot

Bacterial leaf spot

VIRAL DISEASES

Disease	Crop (s) severely affected	Transmission	Symptoms	Management
Cucumber Mosaic Virus (CMV)	All cucurbits	Aphids, sap and mechanical tools	Mild mottling, vein clearing, puckering of leaves. Plants remain stunted	Destroy affected plants away, Manage the insect vectors
CGMMV	Cucumber	Seeds, mechanical tools and irrigation water	Slight vein clearing, crumpling, blistering and distortion of leaves	Destroy affected plants Use disease free seeds Disinfection of tools and hands

Disease	Crop (s) severely affected	Transmission	Symptoms	Management
Bud necrosis (a strain of TOSPO)	Watermelon	Thrips, sap and mechanical tools	Buds turn brown and die Concentric rings on fruits	Till now no management is recommended
Zucchini Yellow Mosaic (gemini) Virus	Pumpkin and squashes	Whitefly	Vein clearing of young leaves, older leaves show severe mosaic symptom	Manage whitefly Repallent mulching Use resistant variety



Bud necrosis

ZYMV

PEST MANAGEMENT

Pest	Nature and symptoms of damage	Management
Red pumpkin beetle (*Aulacophora fovicilis)*	Mostly attack in cotyledonary stage, eat away the cotyledonary leaves, plants die	Spray carbaryl (0.2%) or Dimethoate (0.1%) at cotyledonary leaf to 4 true leaf stage
Aphids (*Aphis gossypii* and *Myzus persicae*)	Suck sap from under surface of leaves, plants become weak, remain stunted. These also acts as vectors of various viral diseases	Spray the crop with Dimethoate (0.1%) or Malathion (0.1%)

Red pumpkin beetle

Aphids

Pest	Nature and symptoms of damage	Management
Fruit fly (*Dacus dorsalis* and *D. Cucurbitae*)	Adults lay eggs below the developing fruit epidermis and maggots feed inside fruits and cause rotting. More severe during rainy season	Place light and methyl eugenol traps to attract male adults Place poison bait (2 ml Malathion + 20 g jaggery /l of water)
Root Knot Nematode (*Meloidogyne incognita)*	Plants remain stunted, show wilting during thee hotter part of the day and recovers during nights Knots are easily seen at the roots	Long crop rotation with rice Application of Nemagon or Phorate 10G @ 3 kg per hectare Grafting on resistant rootstocks

Root knot nematode infestation

Fruit fly infestation

Advances in seed production

- **Isolation Distance**
  - Foundation seed: 800 m
  - Certified seed: 400 m
- **Crossable species**
  - Muskmelon from snap melon and long melon
  - Cucumber from Indian wild cucumber (*C. sativus* var. *hardwickii*)
  - Watermelon from round melon and wild sp. (*Citrullus colocynthis)*
  - Bitter gourd from wild species (*M. charantia* var. *muricata*)
  - Bottle gourd from wild species (*Lagenaria sphaerica*)
  - Pumpkin from squashes
- **Rouging**
  - Early vegetative stage
  - Before opening of first flower
  - At fruiting and harvest stage

Available online at http://www.ijabbr.com

International journal of Advanced Biological and Biomedical Research

Volume 2, Issue 4, 2014: 1030-1037

The Effects of Pruning and Potassium Nutrition on some Morphological traits and Seedling Properties of Pumpkin (Cucurbita pepo L.)

Behrooz Esmaielpour [1] and Saeid Hokmalipour [2]

Treatment code	Treatments
T_1	No pruning
T_2	Pruning after 8th node
T_3	Pruning after 12th node
T_4	No potassium (0 kg/ha)
T_5	Potassium @ 75 kg/ha
T_6	Potassium @ 150 kg/ha

T_1 recorded highest fresh weight (93.22 g) of seeds, germination percentage and root and shoot dry weight (0.30 mg and 0.59 mg respectively)

T_6 recorded maximum number of seeds per fruit (179.1) and 1000 seed weight (178.9 g)

They interpreted the result of non pruned plants as higher source and lower sink resulted into superiority whereas higher potassium level helped in greater translocation of the assimilates to the fruits resulted superiority as compared to that of lower potassium levels

They concluded that no pruning along with higher level of potassium (150 kg/ha) to be practiced for getting higher quantity and better quality pumpkin seeds

HYBRID SEED PRODUCTION

- Significant heterosis for earliness and yield has been reported for most cucurbits
- Insignificant inbreeding depression helps to produce inbred lines easily

Methods for hybrid seed production

- **Hand emasculation and pollination** in andromonoecious and hermaphrodite species
- **Manual defloration of male flowers** (pinching before anthesis) from female parents in monoecious species
- **Use of gynoecious lines**
- **Use of genetic male sterility** (single recessive gene governs male sterility in cucumber, muskmelon, watermelon and squashes) as female parent
- **Epigenic conversion** towards femaleness form by using ethephon in monoecious cucurbits

Selection of best combiner inbreds, maintaining proper isolation, following any of these methods and keeping bee hives for insect pollination give more seed yield

(Robinson RW, 2000)

PROCEDURE

- Isolation of staminate and pistillate flowers by bagging one day prior to anthesis
- Next day pollens shed from paternal parent to maternal parent
- After hand pollination pistillate flowers are covered again for 4-5 days
- Collection of hybrid seed from ripe fruits

Fruit harvesting and seed extraction

- Appropriate stage of maturity is important to determine seed quality
- Early or late harvesting causes quality deterioration

Stage for seed extraction and seed yield

Crop	Days after pollination	Seed yield (kg/ha)
Muskmelon	40-45	100-150
Cucumber	35-40	80-150
Watermelon	45-50	200-300
Bitter gourd	28-30	60-120
Bottle gourd	45-50	60-120
Pumpkin	65-70	100-300

ADVANCES IN BREEDING

BOTANICAL FEATURES

- **Stems:** Angular, slender, hollow and hairy
- **Leaves:** Petiolate, 3-5 lobbed, palmate, alternate in arrangement
- **Flowers: Epigynous,** solitary, axillary, monoecious (cucumber, watermelon, bitter gourd, bottle gourd and pumpkin); andromonoecious in muskmelon
- **Calyx:** Superior, calyx tube connects with the ovary
- **Corolla:** Corolla campanulate, 5 lobbed, **yellow** in (cucumber, watermelon, bitter gourd and pumpkin) and **white** in bottle gourd
- **Androecium:** Stamens are three, anthers adhere to corolla tube, pistillodes are present
- **Gynoecium: Inferior, tri-carpellary ovary**
- **Fruits:** Hard rind, many seeded (except in chow chow) berry, known as "**pepo**"

(Kumar *et al.* 2014)

FLORAL BIOLOGY

Crop	Anthesis time	Anther dehiscence	Stigma receptivity
Muskmelon	5.30-6.30 am	5.00 to 6.00 pm	2 hrs before anthesis and 3 hrs after anthesis
Cucumber	5.30-7.00 am	4.30-5.00 am	12 hrs before anthesis and 7 hrs after anthesis
Watermelon	6.00 – 7.30 am	4.45 – 6.30 am	2 hours before and 3 hour after anthesis
Bottle gourd	5.00-8.00 pm	1.00-2.30 pm	Up to 60 hrs of anthesis
Bitter gourd	5.00- 10.30 am	7.00-8.00 am	1 day before anthesis and o1 day after anthesis
Pumpkin and squashes	7.00-9.00 am	6.30-8.30 am	2 hours before and 2 hours after anthesis

(Kumar *et al.* 2014)

BREEDING OBJECTIVES

Muskmelon

- ✓ Earliness
- ✓ Short vines
- ✓ Yellow thick flesh
- ✓ Smaller seed cavity
- ✓ High TSS (11-13%) and flavour
- ✓ Good keeping quality
- ✓ Good transportability
- ✓ High early and total yield
- ✓ Resistance to diseases like Fusarium wilt, Powdery mildew, downy mildew and viral diseases
- ✓ Resistance to pests like red pumpkin beetle, fruit fly, aphids and nematodes
- ✓ Resistance to abiotic stress like seed germination at low temperature and salinity

Cucumber

- ✓ Earliness
- ✓ High female : male sex ratio
- ✓ Short vine length with short internodes
- ✓ Light green, green and white skin colour
- ✓ Cylindrical fruits without crook neck
- ✓ Few or no spines, preferably white
- ✓ Few soft seeds at edible stage
- ✓ Fruits free from bitterness
- ✓ Edible fruits without carpel separation
- ✓ Higher yield, longer fruit duration and more number of fruits per plant
- ✓ Resistance to diseases like anthracnose, powdery mildew, CMV and insect pests

Bottle gourd

- ✓ Vigourous and well branched plants
- ✓ Earliness
- ✓ Higher female : male sex ratio
- ✓ Fruits having glossy green surface and bitter less
- ✓ Late fiber development in fruits
- ✓ Resistance to diseases like *Fusarium* wilt, powdery mildew and viral diseases and insects like red pumpkin beetle
- ✓ Soft seeds at edible stage

Bitter gourd

- ✓ Long growing well branched vines
- ✓ High female : male sex ratio
- ✓ Lesser number of seeds per fruit
- ✓ Moderate bitterness
- ✓ Yield
- ✓ Resistance to important diseases and pests

Watermelon

- ✓ Strong long vines with more number of branches
- ✓ Earliness
- ✓ Firm flesh, red or pink coloured
- ✓ Fewer and small seeds
- ✓ TSS (more than 10^{o} B)
- ✓ Good transportability and storage life
- ✓ Higher number of marketable fruits per plant
- ✓ Higher yield per plant
- ✓ Resistances to diseases such as anthracnose, Fusarium wilt, powdery mildew and insects like fruit fly and red pumpkin beetle

Pumpkin and squashes

- ✓ Medium or short vines
- ✓ Earliness
- ✓ High female : male sex ratio
- ✓ Thick, yellow coloured flesh
- ✓ Pleasant aroma
- ✓ Resistance to important diseases like powdery mildew and viruses and pest like red pumpkin beetle

Breeding methods employed

Conventional

Introduction
Selection
Hybridization
Backcross method
Mutation breeding
Polyploidy

Non conventional

Somaclonal variation
Genetic engineering through Recombinant DNA technology

Introduction

Crop	Variety	Introduced from
Cucumber	Japanese Long Green	Japan
	Straight Eight	USA
	Poinsett	USA
Water melon	Asahi Yamato	Japan
	Sugar Baby	USA
	Improved Shipper	USA
Summer Squash	Patty Pan	USA
	Australian Green	Australia

Sel ction

	Pusa Madhuras	Local Collection of Rajasthan
Muskmelon	Hara Madhu	Local Collection of Haryana
	Arka Jeet	„Bati" strain of UP
Cucumber	Sheetal	Local material of MH
Watermelon	Durgapura Meetha	Local cultivar
	Durgapura Kesar	Local strain
Bitter gourd	Pusa Visesh	Local variety of Hapur, UP
	Priya and Preethi	Local germplasm of Kerala
	Arka Harit	Germplasm collected from Rajasthan
Bottle gourd	PSP Long and PSP Round	Local germplasm
	Arka Bahar	Local cultivar of Karnataka
	Samrat	Local germplasm of Dahanu district of MH
Summer Squash	Punjab Chappan Kaddu	Inbred from segregating local variety of Punjab
Pumpkin	Arka Chandan	Germplasm of Rajasthan
	Pusa Viswas	Local line „CM 10"

Hybridization followed by selection

Crop	Variety	Parentage
Muskmelon	Pusa Sharbati	Kuntana x Resistant No. 6
	Punjab Sunheri	Hara Madhu x Edisto
	Punjab Rasila	WMR 29 x Hara Madhu
Cucumber	Himangi	Poinsett x Kalyanpur Ageti
	Phule Shubhangi	Poinsett x Kalyanpur Ageti
Watermelon	Arka Manik	IIHR 21 x Crimson Sweet
Bitter gourd	Phule Green	Green Long x Dehli Local

Heterosis breeding

Crop	Variety	Parentage
Muskmelon	Pusa Rasraj	Monoecious 3 x Durgapura Madhu
	Punjab Hybrid	ms 1 x Hara Madhu
Cucumber	Pusa Sanyog	Japaneese Gynoecious line x Long Green Naples
Watermelon	Arka Jyoti	IIHR 20 x Crimson Sweet
Bottle Gourd	Pusa Meghdoot	PSP Long x Sel. 2
	Pusa Manjari	PSP Round x Sel. 11
Summer Squash	Pusa Alankar	EC 207050 x Sel. 1

Mutation breeding

Crop	Variety	Mutation method
Bitter gourd	MDU 1	50 Kr gamma irradiation on seeds of local cultivar (MC 103)

Journal of Tropical Agriculture 51 (1-2) : 144-148, 2013

Short communication

Heterosis breeding exploiting gynoecy in cucumber (*Cucumis sativus* L.)

C.K.Airina[1*], T. Pradeepkumar[2], T.E. George[2], P.G. Sadhankumar[2] and S. Krishnan[3]

EC- 709119 (a stable gynoecious line from USA) was taken as female parent and 12 monoecious lines as male parent and produced 12 top cross hybrids

13 parental lines and 12 hybrids were evaluated in the next season

- EC 709119 x CS 123: highest number of fruits per plant
- EC 709119 x IC 410617: superior for fruits per plant, number of harvests and yield per plant.
- EC 709119 x CS128: superior for fruit length, fruit girth and maximum earliness
- EC 709119 x IC 538155: highest yield per plant but fruits were not attractive
- EC 709119 x IC 538155: maximum crispiness that is desired in salad cucumber

They suggested for further testing of these hybrids for commercial exploitation of heterosis

Varietal improvement work in cucurbits undertaken by Dept. of Vegetable Science, UHF, Nauni

Crop	Varieties	Varietal descriptions
Cucumber	Khira 75	Local selection, prolific growth, fruits are well filled up to end, smooth, light green, cylindrical and 10-15 cm length. Ready for picking after 75 days
	Khira 90	Local selection, vigourous vines. Fruits are well filled up to end, smooth, light green, cylindrical, 15-20 cm long. Ready for picking after 90 days
	KH 1	Early maturing $F_{1,}$ bears 10-12 cm long fruits, ready for harvesting in 65 days, yields 3-40 t/ha
	KH 2	Vines reach up to 5m with 4-5 lateral branches, fruits are cylindrical, 20-23 cm in length, black spine. Average yield 55-60 t/ha. Suitable for low temperature areas
Bitter gourd	Solan Hara	Fruits are 20- 25 cm length and 4-5 com thick, green, white fleshed and spongy with high keeping quality. Ready for harvesting in 75 days, yields 15-17.5 t/ha
	Solan Safed	Fruits are 22-25 cm length and 4-6 cm thickness, takes 80 days for maturity, yield 17.5 t/ha
Pumpkin	Solan Badami	Vigourous vines, early, prolific bearer (40-50 t/ha), orange coloured medium sized fruits having thick flesh and good keeping quality

TRANSGENIC VARIETIES

Transgenic Res (2012) 21:983–993
DOI 10.1007/s11248-011-9585-8

ORIGINAL PAPER

Development of transgenic watermelon resistant to *Cucumber mosaic virus* and *Watermelon mosaic virus* by using a single chimeric transgene construct

Ching-Yi Lin · Hsin-Mei Ku · Yi-Hua Chiang · Hsiu-Yin Ho · Tsong-Ann Yu · Fuh-Jyh Jan

American Journal of Experimental Agriculture
2(3): 525-541, 2012
SCIENCEDOMAIN *international*
www.sciencedomain.org

On the Impact of *Zucchini Yellow* and *Watermelon Mosaic Viruses* on the Production Rhythms of Transgenic ZW-20 and Nontransgenic Squash (*Cucurbita pepo* L.)

Ferdinand E. Klas[1*]

Sex expression and its modification

- It is a complex phenomenon
- Up to eight sex forms are found in different species
- Hermaphrodite is most primitive and Monoecious is most advanced form`
- Further, it depends upon
  - **genetic makeup** of the variety
  - prevailing **temperature** and **photoperiod**
  - **time of planting**
  - **sequential fruit harvest**
  - **nutrition** and **irrigation** management
  - endogenous level of **phytohormones**
  - exogenous application of **plant growth regulators**

SEX MODIFICATION THROUGH CHEMICALS AND PGRS

	Chemical (s)	Concentration (ppm)	Crop (s)
For inducing staminate (male) flowers	Gibberellic acid (GA_3)	1500-2000	Most monoecious cucurbits
	Silver nitrate ($AgNO_3$)	200-300	
	Silver thiosulphate ($Ag_2S_2O_3$)	300-400	
	Amino ethoxy vinyl glycine (AVG)	50-100	
For inducing pistillate (female) flowers	Tri-iodo benzoic acid (TIBA)	25-50	Watermelon
	Ethrel	250-400	Bottle gourd Bitter gourd
	Ethrel	250-500	Rest all monoecious sp.
	Napthalene Acetic Acid (NAA)	25-100	Ridge gourd, Sponge gourd
	Maleic hydrazide (MH)	50-150	Most monoecious sp.

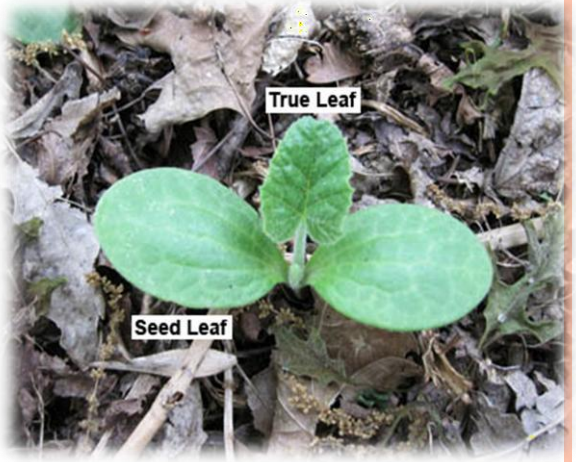
SEX MODIFICATION THROUGH CULTURAL METHODS

- For induction of femaleness:
  - ✓ Application of lower doses of nitrogenous fertilizers
  - ✓ Cultivation when short day length and lower temperature prevail
  - ✓ Grafting on higher ethylene producing rootstocks
  - ✓ Pruning of main vine to promote axilary branches
- For induction of maleness:
  - ✓ Application of higher doses of nitrogenous fertilizers
  - ✓ Excessive irrigation
  - ✓ Cultivation when long days and high temperature prevail

Induction and Morphological Characterization of Hermaphrodite Flowers in a Gynoecious Line of Bitter Gourd by Silver Nitrate, Gibberellic Acid, and Silver Thiosulfate

Mishra Smaranika, Behra TK and Munshi AD. 2015

- Isolated gynoecious line (DBGy-1) of bitter gourd from *Momordica charantia* var. *muricata* and studied the effect of Silver nitrate (SN), Giberellic Acid (GA_3) and Silver thio-sulphate (STS) at different concentrations for pure maintenance
- Treatments- SN: 1.2 and 1.5 mM; GA_3 : 2.9 and 4.3 mM; STS: 3 and 6 mM
- Treatment with SN showed no significant effect on hermaphrodite flower induction
- GA_3 at both concentration resulted increased vegetative growth, rudimentary stamen with non viable pollen
- STS @ 3 mM and 6 mM induced staminal tissue in female flower making them hermaphrodite
- Treatment with STS @ 6 mM recorded highest altered sex expression that was also 10 days earlier as compared to treatment STS @ 3 mM



International Journal of Vegetable Science **21**:204–211

African Journal of Plant Science Vol. 5(10), pp. 599-608, 27 September, 2011
Available online at http://www.academicjournals.org/AJPS
ISSN 1996-0824 ©2011 Academic Journals

Effect of seed soaking treatment with growth regulators on phytohormone level and sex modification in cucumber (*Cucumis sativus* L.)

Hidayat Ullah[1]*, Asghari Bano[2], K. M. Khokhar[1] and T. Mahmood[1]

- Seeds were soaked in distilled water, ethrel (700, 1750, 2750, 3800 µmol/L); GA_3 (15, 30, 45, 60, 75 µmol/L) and MH (450, 675, 900 µmol/L) 20 hours before sowing, taking untreated seeds as control
- Treatment with MH @ 450 µmol/L recorded highest pistillate flowers/plant (36.3), TSS (3.23° B), fruit/plant (25.7), fruit yield/ plant (3.80 kg) and lowest male: female sex ratio (12:4)
- GA_3 @ 30 µmol/L increased chlorophyll content of leaves and Leaf Area Index
- MH @ 450 µmol/L has recorded maximum IAA content at blooming and fruiting stage
- Indigenous IAA content at blooming and fruiting stage had positive significant correlation with number of pistillate flowers (0.795), fruits (0.634) and yield per plant (0.757) and also recorded negative significant correlation with sex ratio (-0.719)
- Concluded that treatment with MH @ 450 µmol/L has better potential to alter sex towards femaleness and can be used at commercial scale.

BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE

NEED FOR RESISTANCE BREEDING

- Heavy application of pesticides increases the cost of cultivation as well as cause health hazards upon consumption
- Non-judicial use of pesticides causes environmental pollution and develop resistance
- Spraying of insecticides and fungicides are not much effective in vine crops
- Cucurbits are sensitive to sulphur and some acaricides
- Viral diseases have wide host range and vectors. Therefore they are very difficult to manage
- The major pest, fruit fly (*Dacus cucurbitae*) is very difficult to manage by chemical insecticides
- A major area of our country is covered by different stresses such as moisture, temperature (both high and low) and salinity
- Stress causes reduction in growth of plants, early senescence and ultimately reduces the yield resulting from low photosynthetic rate and rise in respiration
- During stress, there is change in nutrient uptake and translocation, change in metabolism of nitrogen and sugar
- Cucurbits are the potent crops for riverbed cultivation during November-December when the temperature is low in north India. Protection is required from strong cold desiccating wind.

Indian Journal of Agricultural Sciences **81** (5): 398–401, May 2011

Inheritance of salt tolerance in cucumber (*Cucumis sativus* L.)

JAGESH K TIWARI[1], ANILABH D MUNSHI[2], RAVINDER KUMAR[3], RAM KUMAR SHARMA[4] and AMISH K SUREJA[3]

- Studied inheritance pattern of salinity tolerance by combining ability and gene action analysis
- Studied salt tolerant and salt sensitive inbreds (produced through 5 generation of selfing) and their hybrids
- Salinity levels: 0.43dS/m (control) and 4.00 dS/m
- Higher value of GCA than that of SCA was obtained and narrow sense heritability was recorded between 50-100%
- Results indicated predominance of additive gene action for salt tolerance in cucumber
- They suggested either hybridization followed by selection or simple recurrent selection methods for improvement of salinity tolerance in cucumber

BIOTIC STRESS RESISTANCE

Major biotic stresses in cucurbits

Diseases	Causal organism(s)	Crop(s) severely affected
Fusarium wilt	*Fusarium oxysporum* f.sp. *melonis*	Muskmelon, Cucumber
	Fusarium solani	Watermelon
Powdery mildew	*Sphaerothica fuliginea* *Erysiphe cichoracearum*	Cucumber, Musk melon, Bottle gourd, Pumpkin
Downey mildew	*Pseudoperenospora cubensis*	Muskmelon, Cucumber, Ridge gourd
Anthracnose	*Colletotrichum laginarium*	Cucumber, Watermelon, Bottle gourd
Fruit fly	*Dacus cucurbitae*	Cucumber, All gourds, Melons
Red pumpkin beetle	*Aulacophora fovicilis*	Muskmelon, Cucumber, Round melon
Viruses	CMV, CGMMV	Cucumber, Melons, gourds and Pumpkin

BIOTIC STRESS RESISTANT SOURCES

Muskmelon

- PM: PMR 45, PMR 450, PMR 6, PI 124111
- DM: MR 1, PI 414723, DMDR 1, DMDR 2
- CGMMV:DVRM-1, 2, *C. africanus*, *C. ficifoilus*, *C. anguria*
- Fruit fly: *C. callosus*
- Nematode: *C. metuliferus*
- Whitefly: *C. asper*, *C. denteri*, *C. dispsaceus*, *C. sagittatus*

Bottle gourd

- CMV and WMV: PI 271353
- *Fusarium* wilt: Renshi (Taiwan)

Cucumber

- ✓ Anthracnose: PI 175111, PI 175120, PI 179676, PI 182445
- ✓ DM: B 184, B 159
- ✓ PM: PI 200815, PI 200818, *C. hardwickii*
- ✓ CMV: Wise SMR 12, SMR 15, SMR 18

Watermelon

- *Fusarium* wilt: Summit, Conqueror, Cherleston Gray, Crimson Sweet
- Anthracnose: Fair, Cherleston Gray, Congo, PI 189225

Pumpkin

- ❑ PM and viruses: *C. lundelliana*, *C. martenezii*
- ❑ ZYMV and WMV: *C. ecuadorensis*, *C. foetidissima*, *C. martenezii*

(Rai *et al*. 2008)

PM: Powdery Mildew, DM: Downy Mildew, CMV: Cucumber Mosaic Virus, CGMMV: Cucumber Green Mottle Mosaic Virus, WMV: Watermelon Mosaic Virus, SqMV: Squash Mosaic Virus

ACHIEVEMENTS IN RESISTANCE BREEDING

- **Musk melon:**

Punjab Rasila: Resistant to powdery mildew and moderately resistant to downy mildew

Arka Rajhans: Tolerant to powdery mildew

- **Cucumber:**

Poinsett: Resistant to downy mildew, powdery mildew, anthracnose and angular leaf spot

Himangi: Resistant to bronzing

Phule Subhangi: Resistant to downy mildew

Pusa Barkha: Resistant to high temperature, high humidity and downy mildew

- **Watermelon:**

Arka Manik: Resistant to powdery mildew and downy mildew and resistant to anthracnose

- **Bitter gourd:**

Phule Green: Tolerant to downy mildew

- **Bottle gourd:**

Pusa Santusthi: Tolerant to both high and low temperature

Punjab Komal: Tolerant to Cucumber Mosaic Virus (CMV)

- **Pumpkin and squashes:**

Arka Suryamukhi: Resistant to fruit fly (*Daucus cucurbitae*)

Punjab Chappan Kaddu: Field resistance to downy mildew and red pumpkin beetle

BREEDING FOR QUALITY TRAITS

PARTHENOCARPIC CUCUMBER

- Parthenocarpy is the ability to develop fruits without pollination
- This character is governed by incompletely dominant gene „Pc“ (Pike and Peterson, 1969)
- Results early and more regular fruit setting (Zwinkles, 1987)
- Overcomes the inhibitory effect of seed formation on subsequent development of fruits (Lower and Edwards, 1986)
- Parthenocarpy sometimes produce misshapen fruits, therefore, must be combined with combined femaleness (gynoecy)
- Artificial parthenocarpy is induced by treating with chlorflurenol (Tatlioglu, 1993)

SEEDLESS WATERMELON

Flowchart for triploid seed production

Diploid plant (2n)

Colchicine treatment

Tetraploid plant (4n)

Selfed to maintain

Continued as maternal parent

Tetraploid female x diploid male

Fruits having triploid (3n) seeds

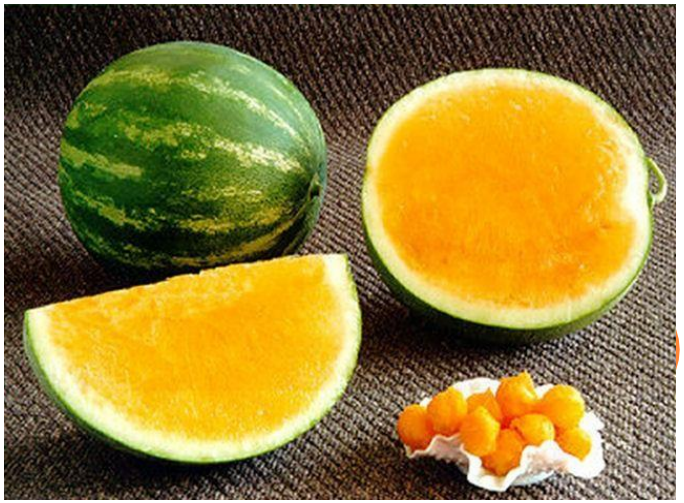
Plants having seedless fruits

Diploid male (2n)

Selfed to maintain

Continued as pollen parent

Triploid varieties in India
Pusa Bedana
Arka Madhura



ELSEVIER

Scientia Horticulturae 84 (2000) 255–264

SCIENTIA HORTICULTURÆ

www.elsevier.com/locate/scihorti

Production of seedless watermelon using soft-X-irradiated pollen

Keita Sugiyama*, Masami Morishita

- ✓ Described a new method for producing seedless watermelon in diploid plants in Japan
- ✓ Treated the whole male flowers of two cultivars „Fujihikari TR“ and „Benikodama“ with 100, 200, 400, 800 and 1000 Gy X-ray and considered un-irradiated as control
- ✓ Doses of 800-1000 Gy in cv. „Fujihikari TR“ and doses of 400-1000 Gy in cv. „Benicodema“ was considered best in terms of small empty seeds
- ✓ Any of the treatments did not affect fruit weight, fruit shape index, rind thickness and days to maturation as compared control
- ✓ Female flowers pollinated with irradiated pollen recorded slightly higher sugar content (from 11.8 to 13.1 %) in cv. „Benicodema“

SQUARE WATERMELON

Why to go for square watermelon?

- Easier to stack, convenient in storage and transportation
- They are designed to fit perfectly inside smaller refrigerators

How to grow square watermelon?

- ✓ Select a small watermelon on the vine, place a square, tempered and transparent glass box tightly around it
- ✓ When the fruit becomes larger, it assumes the shape of the box

ACHIEVEMENTS OF BREEDING FOR QUALITY

Musk melon

Hara Madhu: 12-15^{o}B TSS but poor keeping qulality due to relatively thinner flesh

Punjab Rasila: Early variety, juicy and more flavoured fruits

Durgapura Madhu: Very sweet fruits (14-15^{o}B)

Arka Jeet: Excellent flavour and high vitamin C content

Cucumber

Japaneese Long Green: Extra early variety

Straight Eight: White spined fruit

Himangi: White skin colour

Pumpkin

Arka Chandan: Flesh have good aroma and high carotene content (3331 IU per 100 g)

Watermelon

Asahi Yamato: Deep pink flesh and 11-13^{o}B TSS

Sugar Baby: Pink flesh and small seeds

Pusa Bedana and **Arka Madhura**: Seedless

Arka Manik and Improved Shipper: Stands transport and storage

Bitter gourd

Konkan Tara: Fruits have good keeping quality (Shelf life 7-8 days in ambient condition)

Arka Harit: Fruits have moderate bitterness

Bottle gourd

Pusa Naveen: Fruits are perfectly cylindrical without crook neck

Arka Bahar: Flesh have pleasant aroma and fruits are devoid of crook neck

CONCLUSION

- Cucurbits, being large and diverse group, provide better opportunity to enhance overall production and productivity of vegetable crops
- Soil less culture has given quality produce and eliminate several soil borne diseases
- Grafting technique, use of exogenous PGR, training and pruning system has increased the yield almost twice
- The protected cultivation has allowed crop production irrespective of prevailing weather and ensures off-season availability
- Both the conventional and non conventional breeding methods has led to development of several resistant varieties
- Development of parthenocarpic (seedless) cucumber and seedless watermelon has led to new opportunities towards quality breeding


Thankyou...


TIME FOR QUESTIONS
12
1
2
3
4