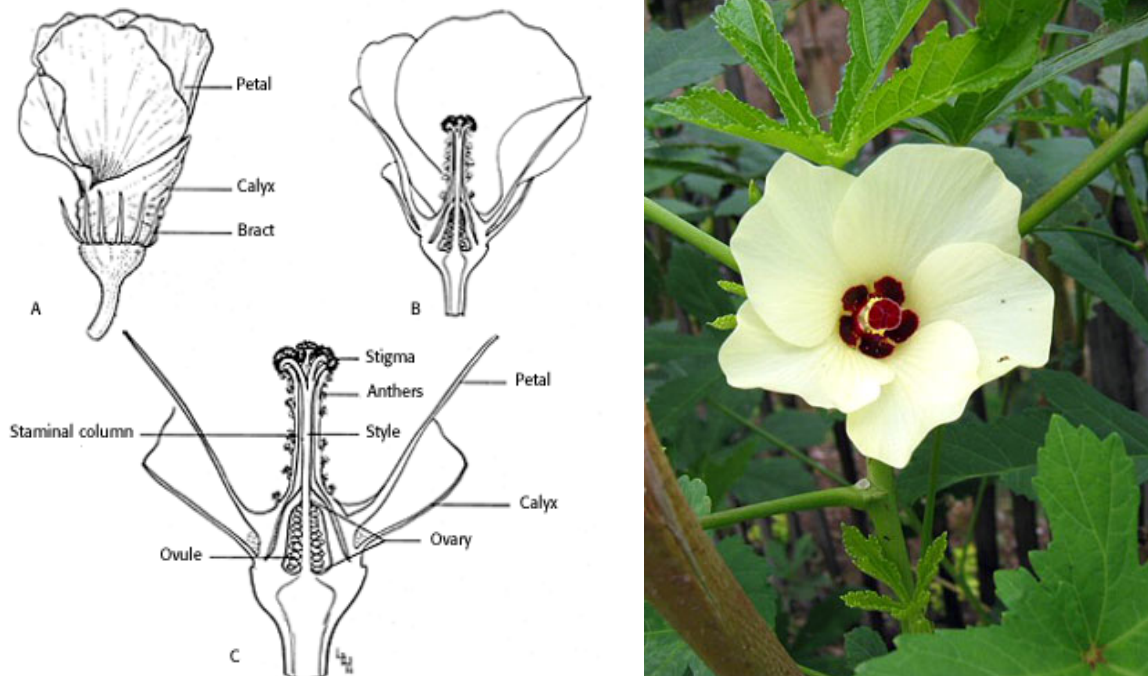


BHENDI (*Abelmoschus esculentus*)

Botany: Anthesis is between 9 and 10 hr and is preceded by maximum anther dehiscence between 8 and 9 hr. The stigma remains receptive on the day of anthesis. Bhendi is an often cross pollinated crop. Cross pollination to an extent of 12 per cent is due to protogynous.



Method of seed production : Seed to seed

Stages of seed production : Breeder seed → Foundation seed → Certified seed.

Varieties : Co.1, MDU.1, Parbhani Kranti, Arka Anamika, Pusa A-4, Pusa Sawani

Hybrids:CO2,CO 3, Mahyco hybrid, Shoba

Season : June-July, September- October and February- March

Land requirement : Select field on which bhendi crop was not grown in the previous season, unless the crop was of the same variety and certified. Field should be free from wild bhendi (*Abelmoschus sp.*)

Isolation requirement: Seed field must be isolated from other varieties at least by 400 M for foundation and hybrid seed production and 200 M for certified seed production.

Seed rate : Varieties : 8-10 kg/ha

Hybrids : 4 kg/ha (Female); 1 kg/ha (Male)

Manuring: Apply 12.5 tons of FYM/ha before ploughing. Apply 150:75:75 kg NPK/ha, of which 50% of the N should be applied as top dressing in two split doses at flowering and 10 days later.

Planting ratio: For hybrid seed production, female and male parents are normally planted in the ratio of 4:1.

Roguing: Minimum of three inspections for varieties and 4 inspections for hybrids, one at vegetative, two at flowering and one at fruit maturity stages. The roguing should be based on the plant characters, hairiness, fruit character like fruit colour, number of ridges, fruit length etc., and the off type and mosaic attacked plants should be removed from the seed field. Wild bhendi if present should be removed before flowering.

Pest and disease management: The major pest attacking bhendi are jassids, aphids and white fly, which can be controlled by spraying Rogar or Dimecron or Endosulphon. The pod borer and red spider mites can be controlled by spraying Endosulphon and Kelthane, respectively. The diseases such as yellow vein mosaic and powdery mildew can be controlled by spraying systemic insecticides and Karathane, respectively.

Hybrid seed production: In bhendi, since the flowers are large in size, hand emasculation and pollination is the best suitable method for seed production. The emasculation and dusting can be done as per the methods outlined in tomato. The male and female parents are raised in blocks at the ratio of 9:1 (Female: Male).

Harvesting: Fruits should be harvested when they have dried (30-35 days after crossing). The pods which expose hairline crack and turn to brown colour on drying alone are cut using sickle manually.



Threshing:

The pods are dried and threshed using pliable sticks. Separated seeds are winnowed to remove plant debris and dried over a tarpaulin to 10% moisture content. Dried seeds are subject to water floatation in which, good seeds sink while poor seeds float. The floaters are removed, while sinkers are dried under shade followed by sun drying. Then the seed are cleaned, dried and treated with Captan/ Thiram.



Processing: Seeds are to be processed with BSS 7 wiremesh sieve.

Seed Yield: 1000-1200 Kg/ha

Specific standards:

Factors	Foundation	Certified
Off types	0.1%	0.2%
Objectionable weed	None	None
Disease affected plants	0.1%	0.5%

Objectionable weed: wild *Abelmoschus sp.*

A. moschatus



A. manihot



Designated diseases: Yellow Vein Clearing Mosaic (Hybiscus virus-1)



Seed standards

Factors	Foundation	Certified
Pure seed	99%	99%
Inert matter	1%	1%
Other crop seed	None	5/kg
Total weed seed	None	None
Objectionable weed	None	None
Other Distinguishable Varieties (ODV)	10/kg	20/kg
Germination	65%	65%
Moisture	10%	10%
For VP Container	8%	8%

Questions

- Chilli is an often Cross pollinated vegetable. (**True**/False)
- The flower of chilli is
 - Protandry
 - Terminal
 - Axillary
 - Protogyny**
- _____ arrests flower drop in chilli.
 - NAA**
 - GA3
 - MH
 - Ethrel
- Off type allowed during certified seed production in chilli is _____
 - 0.5%
 - 0.02%
 - 0.2%**
 - 2%
- Isolation requirement for foundation and certified seed production in chilli is _____
 - 400 & 200 M**
 - 100 & 200 M
 - 600 & 200 M
 - 600 & 400 M
- Bhendi is an often cross pollinated crop. (**True**/False)

7. Cross pollination in bhendi is due to **protogynous**.
8. Isolation requirement for foundation and certified seed production in *Abelmoschus esculentus* is_____
- | | |
|----------------|---------------------------|
| a. 600 & 100 M | b. 200 & 100 M |
| c. 300 & 200 M | d. 400 & 200 M |
9. Planting ratio for hybrid seed production in *Abelmoschus esculentus* is
- | | |
|---------|---------------|
| a. 8:1 | b. 4:1 |
| c. 12:1 | d. 10:1 |
10. Seeds of bhendi is processed with _____ wiremess sieve.
- | | |
|-----------|-----------|
| a. BSS 10 | b. BSS 3 |
| c. BSS 7 | d. BSS 15 |
11. Objectionable weed in bhendi is _____
- | | |
|------------------------------|------------------------------|
| a. <i>Manihot esculentus</i> | b. <i>A.moschatus</i> |
| c. <i>Coleus forskohlii</i> | d. None |
12. Designated diseases of bhendi is **yellow vein mosaic**.
13. Other Distinguishable Varieties (ODV) allowed in bhendi is _____
- | | |
|----------|-----------------|
| a. 5/kg | b. 20/kg |
| c. 10/kg | d. 40 % |

SEED PRODUCTION OF CUCURBITACEOUS VEGETABLES

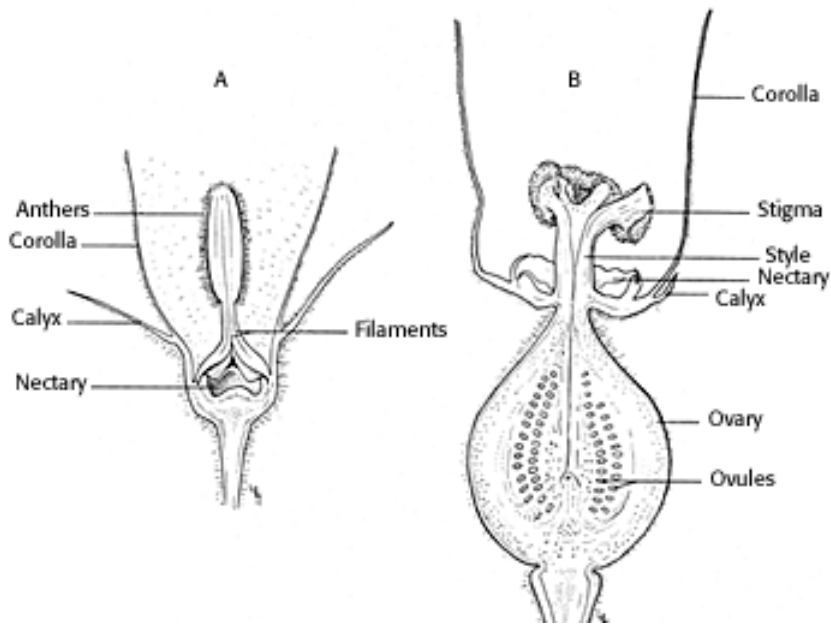
Land Requirements: There are no land requirements as to previous crop, but the land should be free of volunteer plants. Generally the soil should be well drained and aerated.

Isolation Requirements: Most of the cucurbits are monoecious in character and a few are dioecious. A number of [hermaphrodite](#) and [andromonoecious](#) cultivars are also available in some crops. Pollination is largely done by insects. For pure seed production and isolation distance all around seed field is necessary to separate it from fields of other varieties, fields of the same variety not conforming to varietal purity requirements for certification, from wild cucurbit species, and to separate musk melon from long melon and vice versa, and pumpkin from summer and winter squashes and vice versa as follows

Class	Minimum distance (meters)
Foundation	1000
Certified	500

Flower structure in cucurbits





GENETIC PURITY AND SEED HEALTH STANDARDS FOR CUCURBITS

Factors	Minimum permitted level(%)	
	FS	CS
Open pollinated variety		
Off-type	0.10	0.2
Objectional weed plant	None	None
Hybrids		
Off-type in seed parent	0.01	0.05
Off-type in pollen parent	None	0.05
Pollen shedders in seed parent	-	0.10
Seed borne diseases ***		
Muskmelon *	0.1	0.20
Summer squash **	0.1	0.5

Cucumber mosaic virus ,** Cucumber mosaic virus, watermelon mosaic virus

SEED CERTIFICATION STANDARDS IN INDIA FOR CUCURBITS

Factors	Minimum permitted level (%)	
	Foundation seed	Certified seed
Pure seed (minimum)	98	95
Inert matter (maximum)	2	5
other crop seed (maximum)	None	None
Weed seed (maximum)	None	None
Other objectional varieties (only for hybrids)	5/kg	10/kg
Germination (minimum)	60	60
Moisture for ordinary pack (maximum)	7.0	7.0
Moisture for vapour proof pack (maximum)	6.0	6.0

Seed production details in Cucurbitaceous vegetables

Particulars	Bittergourd	Snakegourd	Ribbedgourd	Ashgourd / Pumpkin
Isolation	Foundation seed 1000 m and certified seed 500 m			
Season	June - July and Feb – March			

Varieties	CO1, MDU1, Coimbatore long green & long white	CO1, CO2, PKM1, MDU1	CO1, CO2, PKM 1	CO1, CO2
Seed rate / ha	2.5	2.5	2.5	2.5 / 1.0
female flower increased by	Spraying of Ethrel 200 - 250 ppm at two true leaf stage and after a week of 1 st spray			
Spacing (cm)	Take pits of size 45x45x45 cm at 2.5x2.0 m distance			
Fertilizers / (NPK g/pit)	6:12:6	12:24:12	9:15:9	6:12:6
Physiological maturity	Change of fruit colour in any part or 1/3 of fruit tip to yellow to red		Complete drying of fruits	Change of fruit colour to orange brown in pumpkin and ashy coating and metallic sound in ashgourd
Processing	Hand picking	Hand picking	BSS 4 wire mesh sieve	16/64 round perforated sieve
Fruit to seed recovery (%)	30	15-16	13-14	1.0-1.3
Seed yield (kg/ha)	120-150	220-250	200-250	120-150

Techniques of Hybrid Seed Production in cucurbits

i. Hand emasculating and hand pollination

This technique is frequently used for melon seed production. In this species, andromonoecious lines are common and they must be emasculated and hand pollinated if used as the female parent for producing hybrid seed. This method has also been used for some watermelon and cucumber hybrids. This technique is applicable for limited scale production, since a lot of trained labour is required in pinching, pollen collection and hand pollination.



ii. Hand emasculating and pollination by insect

The male flowers from female lines are pinched off a day before anthesis regularly, which honeybees and other insects (voluntary) use as pollinating agents. The male and female are grown in alternate rows. The fruit set on female lines are of hybrid and harvested for seed extraction. The planting ratio varies within the crops e.g. summer squash 3:1 and 4:1 in muskmelon and cucumber but depends upon the population of bees in the plot. This technique is also used in bottle gourd, pumpkin, muskmelon, cucumber, summer squash and bitter melon for hybrid seed production.

iii. Use of genetic male sterility system

Genetic male sterility system has been utilized for commercial hybrid production in muskmelon. The genetic male sterility in muskmelon is controlled by

single recessive gene (msms). For hybrid seed production, the male sterile line is used as female parent. Since genetic male sterile line is maintained in heterozygous forms, 50% fertile plants are to be removed at flowering. The other 50% having non-dehiscent empty anther are retained in female rows. The female and male are grown in 4:1 ratio. However, to maintain the good plant population in female rows it is suggested that seed parent should be sown with double seed rate. It is also advised that female line seedling should be raised in polythene bags and transplanted at flower appearance in order to avoid the fertile plants in female rows. The pollination is done by honey bees and 1 to 2 medium sizes hives are good enough to ensure the good pollination and fruit set at female row.

The male sterile line is maintained in heterozygous form by crossing with maintainer line under adequate isolation distance or under cover.

iv. Use of gynoecious sex form

The gynoecious sex form has been commercially exploited in hybrid seed production of cucumber. For hybrid seed production female and male rows are planted in 4:1 ratio. The female (seed parent) bear only female flowers and pollination is done by insect (honeybee). To ensure the good fruit and seed recovery, the sufficient population of honeybee 1 to 1½ colony of medium size has to be kept at the boundary of seed production plot to boost the amount of crossing. The parental lines i.e. male parent maintained by selfing (mixed pollination) and rogue out undesirable plants before contamination take place. The female lines i.e. gynoecious lines maintained by inducing the staminate flower through the sprays of silver nitrate 200 ppm at two to four true leaf stage and then selfing is carried out. It was observed that 10-11 male flowers appear per 100 nodes.

The performance of gynoecious lines is unstable under high temperature and long photo period conditions because of their thermo-specific responses for gynoecious stability. That is why the gynoecious cucumber did not receive much attention in the tropical countries. However, few true breeding tropical gynoecious lines in cucumber and muskmelon have been developed at IARI. As a result of development of true breeding line, muskmelon hybrid Pusa Rasraj was developed.

These homozygous gynoecious lines are maintained by using GA₃, 1500ppm or silver nitrate 200-300 ppm or sodium thio sulphate 400 ppm to induce staminate flowers at two and four true leaf stage. Homozygous lines are planted in strict field isolation. The gynoecious lines are crossed with monoecious male parent to produce F1 hybrid.

v. Hybrid seed production through chemical sex expression

The hybrid seed can also be produce in cucurbits by the application of chemicals for attaining the sex of cucurbits. Specific chemicals are known to induce femaleness and maleness as desired. The spraying of ethrel (2-choloro-ethyl-phosphonic acid) 200-300 ppm at two and four true leaf stage and another at flowering is useful for inducing the pistilate flower successively in first few nodes on the female in bottle gourd, pumpkin and squash for F1 seed production. The row of male parent is grown side by the side of female and natural cross pollination is allowed. In the absence of insect, hand pollination is possible when two sexes are separate. Four to five fruit set at initial nodes are sufficient for hybrid seed. The complete suppression of male flowers in squash can be achieved by applying ethrel at higher concentration (400-500 ppm) twice.

The other chemicals like GA₃, (10-25 ppm) in cucumber, MH-(100 ppm), ethephon (600 ppm) in squash induces female flowers.