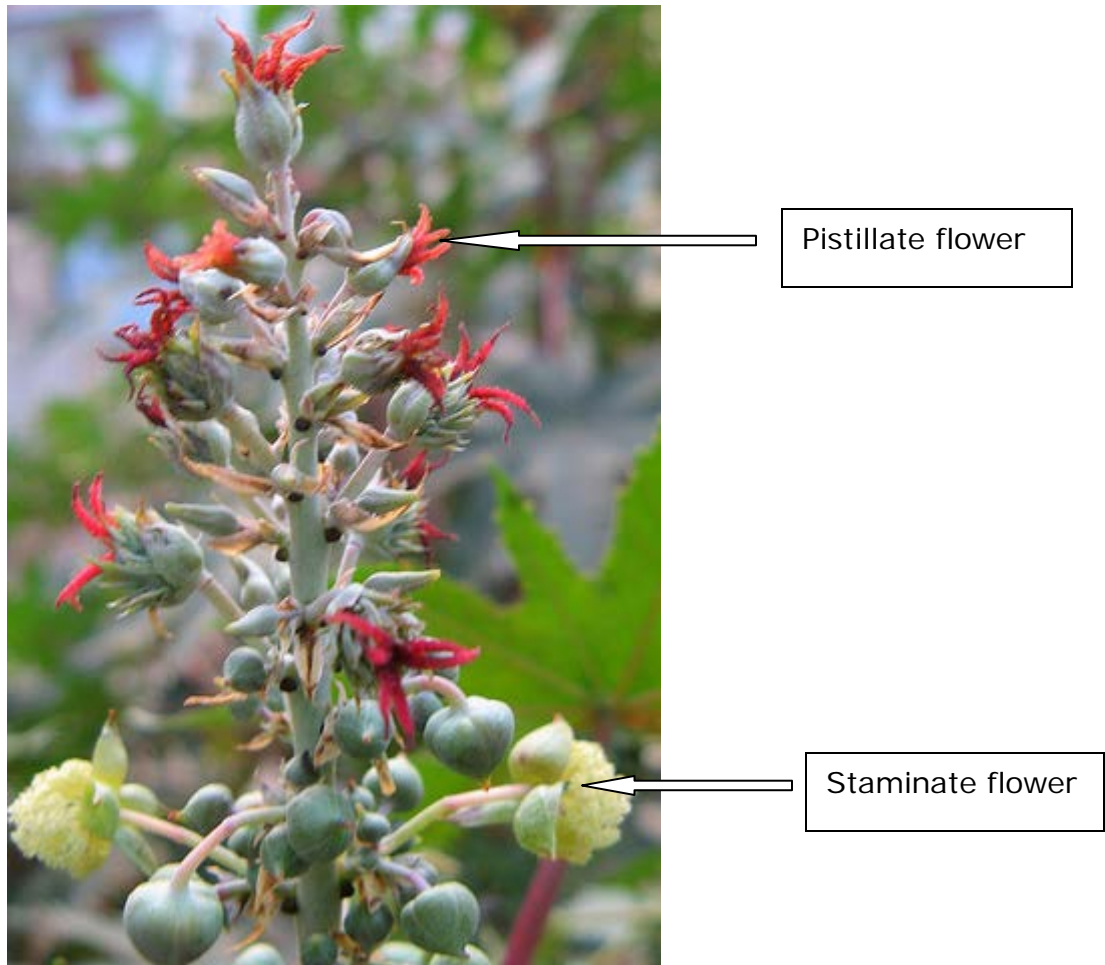


SEED PRODUCTION IN VARIETIES AND HYBRIDS OF CASTOR

Castor and its speciality

- Castor is a cross pollinated crop, [protogynous](#) and wind pollinated. Inflorescences are borne terminally on the main and lateral branches.
- The main stem ends in [raceme](#), which is the first or primary raceme. After the first raceme appears, 2 or 3 branches arise at the nodes immediately below it.
- Each of these branches terminates in racemes after 4 or more nodes have formed which are known as secondary racemes.
- Branches arise from the nodes just beneath secondary racemes, ultimately terminating in tertiary racemes. This sequence of development (indeterminate growth habit) continues.
- The racemes of castor are [monoecious](#) with the [pistillate](#) flowers on the upper 30-50% and [staminate](#) flowers on the lower part of the inflorescence.
- The proportion of pistillate and staminate flowers among the racemes varies a great deal both within and among genotypes. It is influenced by the environment of the plant, genotypes and nutrition.
- Female tendency is the highest in winter, while male tendency predominates in summer and rainy seasons.
- Also, the femaleness in young plants with high levels of nutrition is stronger than in old plants with low levels of nutrition.

Castor raceme



Pistillate mechanism

In addition to monoecism a sub form of dioecism exists in castor, which has led to the identification of 3 different pistillate mechanisms.

1. N type or conventional mechanism

- ✓ It is governed by a recessive sex switching gene. This can be maintained by sibmating. The progeny from seed produced on pistillate plants segregates in 1: 1 ratio of pistillate and monoecious plants. In the production of F1 hybrid seed using the N pistillate line, the producer is required to rogue out normal

monoecious plants before anthesis to obtain 100% production of pistillate plants in the female rows. This has proved difficult to do for 3 reasons.

- ✓ Uneven emergence
- ✓ Variation in time of flowering and
- ✓ Higher percentage of monoecious plants than expected 50 percent.

2. S type or non conventional mechanism

It is derived from reversals, which start out as female and then revert to normal monoecism any time after the first raceme. Use of this pistillate line is beset with the problems of lack of stability of the expression of pistillate character as large number of revertants as well as monoecious plants was observed in the population. Eg. VP 1. This problem was successfully overcome with the exploitation of the NES system.

3. NES system

This line is normally pistillate under moderate temperature but produces interspersed staminate flowers under high temperature. In crossing fields (hybrid seed production plot) usually one or two roguing of the female line are sufficient to ensure that all flowering plants are pistillate to remove off types that appear.

E.g. The original population of VP 1 was thoroughly screened under high temperature to eliminate the monoecious plants as well as early revertants.

The seed setting in the selected totally pistillated lines is facilitated by the production of interspersed male flowers under the influence of environment sensitive genes.

India is the largest producer of castor in the world. In India, Gujarat is the leading state followed by Andhra Pradesh.

Varieties

SA 1, SA 2, TMV 4, 5, 6, CO 1, Aruna, Bhagya and Sowbaghya

Speciality with Hybrids in castor

- ✓ The development of N type pistillate line, N 145-4 has led to the exploitation of hybrid vigour in USA in 1950.
- ✓ A 100% pistillate line TSP 10 R (Texas S- pistillate 10) was released in 1962 in USA.
- ✓ Another stable pistillate line (NES 1) based on environmentally sensitive staminate flower character in combination with recessive sex switching gene released at Davis, California in 1964, is now used.
- ✓ In India, Gujarat first started hybrid seed production in mid sixties.
- ✓ First hybrid in India was released in 1968 in Gujarat as GCH3 (Gujarat castor hybrid) using TSP 10 R x JI 15.
- ✓ Indigenous pistillate line VP 1 was developed at Vijapur and using this GAUCH was released in 1973. But it is susceptible to wilt and root rot diseases.
- ✓ Hence another hybrid GCH 2 was released in 1985.
- ✓ Another hybrid GCH 4 was released in 1986 and is in cultivation.

Hybrids	Female	Male
GCH 3	TSP 10 R	JI 15
GAUCH 1	VP 1	V 19
GCH 2	VP 1	JI 35
GCH 4	VP 1	48-1
TMVCH 1	LRES 17	TMV 5

Land requirement

Well drained fertile soil should be selected. The crop cannot tolerate alkalinity and salinity. It performs well with medium to deep sandy loam and heavy loam soils are highly suited for seed production.

Isolation distance

	Foundation seed	Certified seed
Varieties and Hybrids	600 m	300 m

Season

Rabi / Winter - Hybrid seed production. Summer and [kharif](#) provide ideal male promoting environment for undertaking seed production of the variety, male and female parents of hybrids. [Kharif](#) and summer encourages good expression of less productive plant which could be easily eliminated through timely roguing.

Female parents when raised in male promoting environment produce environmentally sensitive staminate flowers, which are very essential for self-production of the female parents.

Seed and sowing

Seed rate : 10 kg / ha (varieties)
2 kg / ha male and 5 kg/ ha female for hybrids.

Spacing

Varieties : 90 x 20 to 90 x 60 cm
Hybrids : 90 x 40 to 90 x 60 cm

Planting ratio

3:1 or 4 - 6:1

Fertilizer : Basal 40:60: 40 NPK / ha

Top: 1st 20 kg N/ha (40-50 DAS) , 20 kg N/ha. (After 1st picking)

Bloom: Presence of white waxy coating which protects from chilling and jassid attack.

4 types of bloom:

- ✓ No bloom
- ✓ Single bloom - Bloom only on stem
- ✓ Double bloom- On stem, petioles, and lower sides of leaves
- ✓ Triple bloom - On all parts.

Stages of inspection

- ✓ 10 days prior to flowering -Stem colour, inter-node length.
- ✓ During flowering - No. of nodes upto primary raceme
- ✓ Before 1st picking (Spike and capsule character, reversion to monoecious in second order raceme)
- ✓ After 1st picking - Reversion to monoecious or flower initiation in third order raceme.

Irrigation

Critical stages are primordial initiation and flowering stage in differential segmental order branches. Moisture stress in sensitive crop growth stages may lead to production of more male flowers in monoecious varieties.

Harvesting

Castor produces 4 or 5 sequential order spikes, which can be harvested in 3-4 pickings starting from 90-120 days at 25-30 days interval.



Premature harvesting leads to reduced seed weight, oil content and germination. If shattering is not a problem in a variety, harvesting can be delayed until all capsules are fully dried.

Grading

The seeds are size graded using round perforated metal sieve of 8/64".



Field standards

	Foundation seeds	Certified seeds
Off types (Varieties)	0.1	0.2%
Off types (Hybrids)	0.5	1.0%

Seed storage

Seed treatment with Thiram @ 2 g / kg

Storability in Pervious container - 1 year

Storability in Moisture vapour proof container - 2

Seed standards

The graded seed should possess the following characters for certification and sale as certified/ truthfully labelled seeds.

Parameter	Foundation seed	Certified seed
Physical purity (min) %	98	98

Inert matter (max) %	2	2
Other crop seed & Weed Seed (max)	-	-
Other distinguishable variety seeds	5 / kg	10/kg
Germination (min)%	70	70
Moisture content (max)%		
(a) Open storage	8	8
(b) Moisture vapour proof storage	5	5

Questions

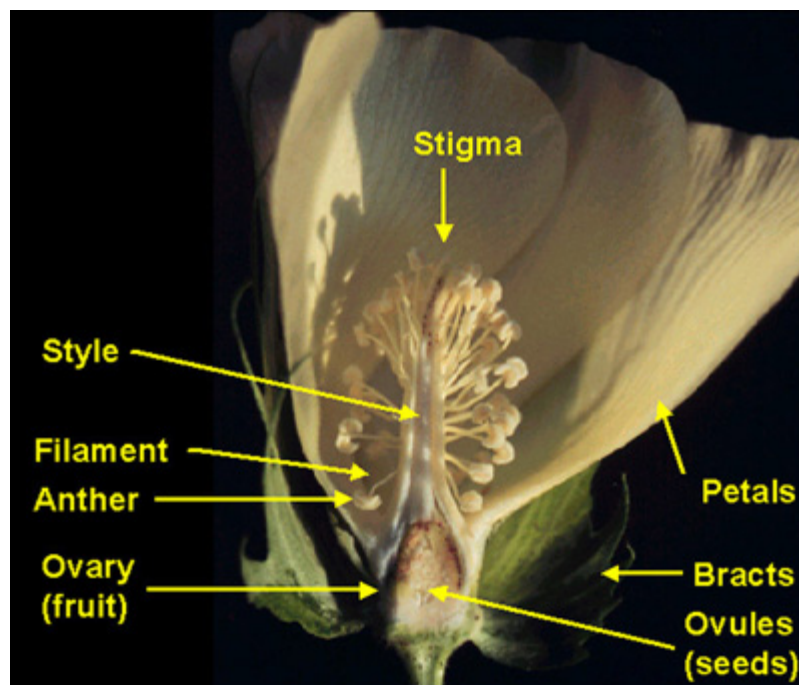
1. Cross-pollination in castor is due to protogynous nature. (**True**/false)
2. The racemes of castor are diecious. (True/**False**)
3. _____ is the first castor hybrid released in India
 - a. CH1
 - b. GCH2
 - c. GCH 3**
 - d. CH2
4. The raceme of castor is monoecious (**True**/false)
5. Isolation distance for certified seed production in castor is_____
 - a. 600 m
 - b. 300 m**
 - c. 200 m
 - d. 400 m
6. Minimum germination percentage for castor certified seed is
 - a. 85%
 - b. 90%
 - c. 70%**
 - d. 60%
7. Pistillate mechanism which start out as female and then revert to normal monoecism any time after the first raceme is _____.
 - a. NES Type
 - b. S Type**
 - c. N Type
 - d. None
8. In which system the line is normally pistillate under moderate temperature but produces interspersed staminate flowers under high temperature.
 - a. N
 - b. S Type
 - c. NES Type
 - d. None
9. _____ is the largest producer of castor in the world.
 - a. Indonesia
 - b. China
 - c. Nepal
 - d. India**
10. Critical stage of irrigation in castor is primordial initiation and flowering stage

SEED PRODUCTION IN COTTON VARIETIES AND HYBRIDS

Cotton botanically as *Gossypium sp.* is a fibre yielding crop. It is known as the queen of fiber crops. It serves as a cash crop to the farmer as the lint serves as the raw material for the textile industry .The seed is used both for multiplication and as animal feed.The success of commercial crop depends on the quality of the basic seed.

Floral biology

Simple, solitary, terminal, extra axillary, petals yellow to cream in colour, hermaphrodite, bracteoles called as epicalyx, three in number, free and deeply serrated and persistent at the base of the flower. Nectary gland is present on each bracteole. Calyx five, united, cup shaped corolla five, polypetalous, a purple spot is present on the inner side of the claw of the petal (petal spot) in some species. Androecium forming a staminal column (monadelphous) bearing numerous anthers. Ovary superior penta carpellary, style slender, passes through staminal column with three to five lobed stigma, ovules many in axile placentation.



There is much variation in case of flower opening. Asiatic cotton opens between 8 and 10. a.m. American cotton opens much earlier. Temperature affects the flower opening. After flower opening the cream yellow colour of corolla turns pink within a day and later changes to red. The receptivity of the stigma is 8 to 10 a.m.



Cotton is an often cross-pollinated crop where the extend of cross-pollination is > 60%. In cotton 4 different species are in popular usage, viz. *G. arboreum* (eg. K 10) *G. herbaceum* (e.g. Uppam) *G. hirsutum* (e.g. MCU varieties) and *G. barbadense* (e.g. Suvin and Suguna).

Method of Seed Production

Varieties: Under isolation, by open pollination, the varieties are multiplied. For nucleus seed production, selfing of flowers is done with cotton (lint) dipped in clay or red earth.

Hybrids: In cotton both inter and intraspecific hybrids are available.

Interspecific Hybrid :

Varalakshmi : Lakshmi x SB298 E (*G. hirsutum* x *G. barbadense*)

DCH 32 / Jayalakshmi : DS 28 x SB 425 (*G. hirsutum* x *G. barbadense*)

TCHB213 : TCH 1218 x TCB 209

Intraspecific hybrid : Suguna, Savitha (T7 x M12)

Tool employed for hybrid

The hybrid seed production in cotton is achieved through emasculation and dusting technique, which is the physical removal of male organ (staminal column) from the female parent.

1. Emasculation and dusting

At the time of flower initiation in female line, the flowers that are going to open next day are selected and the petals are removed between 3-6 pm. With the help of nail or needle, the total staminal (pollen + anther + anther tube) column are removed. Then the flowers are covered with a definite colour cover for easy identification of the emasculated flowers. In the morning between 9 am -12 noon, which is the anthesis time, the flowers of selected male parent are plugged and dusted on the stigma of the emasculated flower on opening the cover. It is again covered with different coloured cover to avoid pollination with other pollen and to identify the emasculated and dusted flower from the rest. The pollen from a single flower is enough to dust 4-5 female flowers. The pollen receptivity of the stigma is for 46 hours.

For easy identification of selfed boll from emasculated and dusted boll the bract can be removed while emasculating owing to the little contribution of bract to seed set and seed yield.



Female flower bud



Emasculated flower bud



Dusted flower bud covered with white paper bag



Hybrid seed production field



Emasculated flower bud covered with red paper bag



Stigma after dusting



Dusting

Particulars of varieties/hybrids

Varieties	Parentage	Season	Irrigated / Rainfed	Seed yield (kg/ha)
Varieties				
MCU 5	Multiple cross	Aug- January	Irrigated	1850
MCU7	X ray irradiation of x L 1143 EE	Jan- Feb. to May - June(summer)	Irrigated (Rice fallows)	1330
MCU 11	MCU 5 x Egyptian hirsutum hybrid derivative	Aug - September	Irrigated	2200
LRA 5166	Laxmi x Reba B.50 x AC 122	Sep-October to Jan - February	Rainfed	725
K10	K9 x 11876 hybrid derivative	Sep-October to Jan - February	Rainfed	726
K11	(0794-1-DX 11876) x (0794-D x 11450) Multiple Hybrid derivative	Oct- March	Rainfed	1100
SVPR 1	MCU 7 x AC 129/2	February - July	Summer - Irrigated	15-16 Qtl. Of kapas /ha
Hybrids				
Suvin	Hybrid derivative from the cross Sujatha x St.Vincent	Aug - February	Irrigated	1020
Jalyalaxmi	Interspecific hybrid of DS 28 <i>G. hirsutum</i> x SB 425 (VF) <i>G. barbadense</i>	Aug-February	Irrigated	2880
TCHB 213	Interspecific hybrid of TCH 1218 <i>G. hirsutum</i> x TCB 209 <i>G. barbadense</i>	Aug-February	Irrigated	2215
Savitha	T7 x M 12 (Intra hirsutum hybrid)	Aug-February	Irrigated	1800
HB 224	It is an interspecific hybrid involving <i>G. hirsutum</i> x <i>G. barbadense</i>	Aug-February	Irrigated	2000

Steps in hybridizing technique

- ✓ Emasculate and dust as far as possible buds appearing during the first six weeks of reproduction phase to ensure good setting and development of bolls.
- ✓ Restrict your emasculation each day evening from 3 pm to 6 pm and pollination in morning between 9-12 noon to ensure highest purity of hybrid seeds. Emasculation should be complete and perfect.
- ✓ Choose optimum size of bud and avoid young or too old buds for emasculation.
- ✓ Cover the male buds with paper bags, previous evening for their use next day.
- ✓ Emasculated buds may be covered preferably with butter papers.
- ✓ Do not forget to tie a thread to the pedicel of the bud immediately after pollination.
- ✓ Close your crossing programme after 9th week (from commencement of crossing) and remove all buds and flowers appearing subsequently to facilitate the development of crossed bolls.
- ✓ Nip the top and side shoots to stop further vertical and horizontal growth.
- ✓ Light irritations should be given as and when required. Excessive or scanty or inadequate irrigations should be avoided especially during crossing and boll development period.
- ✓ Continue irrigation till last picking of the crossed bolls. Frequency of irrigation depends on weather factors like rainfall, temperature and wind velocity.
- ✓ Pick up the ripe and completely opened bolls along with threads and collect in baskets for second sorting. Bolls without threads may be bulk harvested as female seed cotton.
- ✓ Crossed bolls collected in baskets may be sorted out for second time to verify that they are crossed bolls. Then collect the crossed seed cotton and store in gunny bags carefully marked as crossed bolls.
- ✓ Rain touch cotton or hard locks be picked and kept separately to avoid poor germination of hybrid seeds.

- ✓ Store the crossed seed cotton in a cool dry place till it is handed over to processing unit.

Use of Genetic male sterility

Hybrids are also produced by employing genetic male sterility system in cotton, where the female parent will segregate into 50:50 ratio of male sterile and male fertile plants. The male fertile plants are removed and the male sterile plants are crossed with concerned male line.

E.g. Suguna: Gregg x K 3400

Land requirement

The field should be fertile and formed into ridges and furrows. Black cotton soils are highly preferable than other soils. Land should be free from volunteer plants and designated diseases especially the wilt disease.

Season

Winter crop : Aug - Sep

Summer crop : Feb - March

Seeds and Sowing

Seeds should be obtained from an authenticated source with tag and bill.

Pre-sowing management

The seeds can be hardened with 1% prosopis and pungam leaf extract for rainfed/summer sowing to resist water stress problem. Use of delinted seed is better than fuzzy seed to avoid diseased and injured seed.

Seed rate

Varieties : 15 kg/ha (fuzzy seed) 7.5 kg/ha (delinted seed)

Hybrids : 3.75 kg/ha (Jayalakshmi), 1 kg (TCHB 213)

Male : 2 kg /ha and Female 4 kg /ha.

Seed treatment

Treat the seeds with azospirillum at 3 packets (600 g/ha) and 2 kg of azospirillum / ha mixed with 25 kg of FYM and 25 kg of soil and applied on the seed line. This saves 25 % nitrogen besides increasing yield.

Spacing – Varieties

1. Long duration : 90 x 30 cm
2. Short duration : 60 x 30 cm

Hybrids

- ♀ : 120 x 60 cm
♂ : 90 x 60 cm

Hybrids - Planting ratio

8:2 but here it is block system where flowers of 2 parts of male is sufficient to dust 8 parts of female parent.

Isolation (m)

	Foundation seed	Certified seed
Varieties	50	30
Hybrids	50	30

Manures and fertilizers

- Compost : 12.5 tons/ha
Total : 100:50:25 NPK kg/ha
Basal : 50:50:25 NPK kg/ha
Top dressing: 25:0:0 NPK kg/ha
(40-45 days after sowing)
25:0:0 NPK kg/ha (70-75 days after sowing)

Foliar spray

Spray DAP 2% (for female parents, spray on 60,70,80 and 90th days after sowing. (Soak 5 kg of DAP in 25 liters of water over night and supernatant liquid should be taken and mixed with 475 liters of water for spraying 1 hectare).

Micronutrient application

Mix 12.5 kg of micronutrient mixture formulated by the Department of Agriculture Tamil Nadu with enough sand to make a total quantity of 50 kg for one hectare.

NAA application

Spray 40 ppm of NAA (40 mg of NAA dissolved in 1 liter of water) at 40 / 45th day using high volume spray liquid in 1125 liter /ha. Repeat the same dose after 15 days of first spray.

Topping

Topping arrests terminal growth by nipping the terminal 10-12th node for controlling excessive vegetative growth.

Rouging

The crop should be rouged for off types, selfed plants, from vegetative phase to harvest phase depending on plant stature, leaf size, leaf colour, hairiness, stem colour, flower colour, petal spot, pollen colour, number of sympodia, boll size, boll shape, pittedness etc. to maintain genetic purity.

Field standards

	Maximum permitted (%)			
	Foundation seed		Certified seed	
	Varieties	Hybrids	Varieties	Hybrids
Off types	0.1	0.1	0.2	0.5

Irrigation management

Once in 10 days. Critical periods are boll formation to boll maturation stages.

Specific problems

Boll shedding will occur either due to extreme dry climate or lesser frequency of irrigation or physiological disorder.

By spraying 40 ppm of NAA and cycocel at 20ppm, this can be minimized.

Harvesting

- ✓ The seed attains physiological maturation 45 days after anthesis.
- ✓ The initiations of hair line cracks on the dried bolls are the physical symptoms of physiological maturation.
- ✓ At that time, the moisture content will be 30-35%.
- ✓ The bolls are harvested as pickings in cotton.
- ✓ Due to continuous flowering habit once over harvest is not practiced.
- ✓ As and when the bolls burst with hairline cracks the bolls are collected and dried.
- ✓ Normally five to seven pickings can be practiced in a crop.
- ✓ But early 4-5 pickings are recommended for seed purpose.
- ✓ Harvest in the morning hours upto 10 to 11 a.m. only when there is moisture so that dry leaves and bracts do not stick to the kapas and lower the market value.
- ✓ Pick kapas from well burst bolls only.



- ✓ Remove only the kapas from the bolls and leave the bracts on the plants.

- ✓ As kapas is picked, sort out good puffy ones and keep separately.
- ✓ Keep stained, discoloured and insect attacked kapas separately.

Kapas sorting

Kapas is sorted manually to pick good quality seeds. Hard locks are to be removed (Kapas without proper bursting and lint is light yellow in colour), since these kapas mostly result in poor quality seeds, due to boll worm or other insect attack.

Skewed bolls or ill filled or nonviable seeds are formed if stigmatic lobes are not pollinated.

Ginning and certification

- ✓ Gin the crossed kapas in separate gins erected in authorized seed processing units or farm gins under the close supervision of the authorities concerned to ensure purity and avoid seed damage.
- ✓ Sieve the seed in two types of mesh to remove small, shrivelled seeds, broken seeds and clean perfectly from any dirt or dust.
- ✓ After ginning, the seeds should be dried well and cleaned by hand picking. After cleaning, certification agency will take sample for testing germination and genetic purity test. Minimum germination 65% and genetic purity 90% should be maintained.
- ✓ Certified seeds would be bagged in one kg bag, sealed and details regarding its origin, germination, physical purity per cent and genetical purity percent, besides season of production are passed on to sale agencies or respective producers for commercial sale.
- ✓ Uncertified seeds would be procured by the concerned Department or Agency at the market rate for the ordinary cotton seeds for further multiplication. This step is essential to avoid unauthorised sale of substandard uncertified seed.

Processing

The ginned seeds (or) the fuzzy seeds are graded by hand picking and by pressing on wire-mesh sieves to remove the under sized seeds and dust.



Acid delinting

- ✓ Fuzzy seeds will clog with one another. So for easy handling the seeds are delinted using H_2SO_4 @ 100 ml/kg of seed for 2-3 minutes.
- ✓ After acid treatment, the seed should be washed thoroughly for 3 to 4 times with fresh water.
- ✓ From the floaters, mature seeds without any visible damage can be picked and added to the sinkers.

Acid delinting machine



Procedure

Weighed quantity of fuzzy seeds is taken in a plastic container and required quantity of the acid is added. Stir well with wooden rod till a shiny black colour appears (Tar like) wash with more of water (5-6 times) and shade dry the seed to reduce the moisture content to 12% before further handling.

Processing of delinted seed

The free flowing delinted seeds can be graded using 10/64" round perforated metal sieve, which is recommended as standard sieve in OSAW cleaner cum grader for cotton.

The seed can also be graded by specific gravity method by using floatation technique using water. The seeds will separate into floaters and sinkers. The sinkers are good seeds. From floaters, reddish (immature) and damaged (seed with insect hole) are removed. The brownish seeds which are good seeds are hand picked and used for sowing.

Seed standards

Characters	Foundation seed	Certified seed
Physical purity % (min)	98	98
Inert Matter % (max)	2.0	2.0
Other crop seeds (max)	5 kg ⁻¹	10 kg ⁻¹
Weed seeds (max)	5 kg ⁻¹	10 kg ⁻¹
Genetic purity (%)	100	100
Germination (min) % (variety)	65	65
Germination (min) % (hybrid)	75	75
Moisture content (max) %		
a. Moisture pervious	10	10
b. Moisture vapour proof	6	6

Seed storage

The seeds can be stored upto 8-9 months in moisture pervious container and upto 12-15 months in moisture vapour proof containers.

The seed treatment with thiram @ 2.5 kg^{-1} or chlorine based halogen mixture @ 3 g kg^{-1} will protect the seed from storage fungi *Aspergillus* spp and preserve the storability.

Mid storage correction

- ✓ The fuzzy and delinted seeds can be soaked in double the volume of 10^{-4} molar solution of Na_2HPO_4 for 2 and 1 hr respectively (3.59 g / 100 l of water.)
- ✓ Then the seeds are shade and sun dried to bring back to the moisture content of 10-12%. The mid storage correction improves the planting value of old seeds.
- ✓ Dead seeds may be removed by soaking acid delinted cotton seeds in monolayer for 3 h and drying back to original moisture content.
- ✓ The seeds when put into potable water will separate into sinkers and floaters. Dead seeds become buoyant and float.