

Lecture 15

Sugarcane (*Saccharum officinarum*) (2n = 80)

Cross pollination is the rule in sugarcane. Self male and female sterility, protogyny and hanging down of anthers away from the stigma at the time of anthesis promote self pollination. Usually anthesis will be in early morning between 5 am and 6 am. Maximum anthesis between 6 am and 8 am. Stigma protrudes out first and anthers dehisce afterwards. Flower opening will be from top to downwards. It will take about 10 days for complete opening of spikelets. Flowering in sugarcane is location specific and influenced by environment. Natural pollination is by wind (*Anemophily*)

Selfing

Selfing is done by covering the arrow with a bamboo frame work or cage which is covered with muslin cloth or polythene paper. Such a cover is commonly called lantern. It prevents accidental cross pollination. The lantern has to be supported by bamboo poles. The lantern has to be opened once in a day to reduce the temperature that may build up inside during the day time. This is done preferably during the afternoon hours between 12am and 4pm. Usually the cover has to be retained in position till the seeds are set. Within one week or 10 days we can get selfed seeds. This selfing method is followed in Sugarcane Breeding Institute, Coimbatore.

Crossing

Hybridization is very difficult.

1. It is mostly vegetatively propagated. Some varieties seldom flowers outside tropics. Some varieties flowers once in 6 to 8 months. It is highly controlled by photoperiods.
2. Spikelets are minutes. So, hand emasculation is not possible.
3. Self sterility of both pollen and ovule predominates in almost in all the varieties.
4. Hot water treatment can not possible.

Hybridization methods

Coimbatore method

During flowering period, the sugarcane stem will be cut leaving one or two bud. The cut stem can be transferred to a mud pot having moist mud. Within 10 days the buds will develop into roots and there will be good root system. This can be transferred to the breeding block. In the crossing block, the male and female plants are covered with common **lantern**. Free shedding

pollen over female plant will occur. We can harvest both selfed and crossed seeds from the female parent. The selfed seeds can be identified by chromosome number by raising it in the nursery. Selfed seeds thus removed retaining crossed seeds.

Marcotting method

During flowering, cut around the stem and tie a polythene bag with nutrients (growth medium). The bud near cut end give rise to roots. This can be cut and used for hybridization purposes. This method is called marcotting. Practiced in Sugarcane Breeding Institute, Coimbatore.

Lantern method

Providing Lantern for a female plant before anthesis starts. From the desired male parent cut the arrow. That arrow can be introduced into the Lantern and shaken up and thereby crossing can be effected. This will be repeated for 2-3 days in order to have more seed set.

Hawaii method (Sulfurous acid Technique)

A sulfurous acid solution keeps the inflorescence alive for several weeks. Here, we cut both mal and female flowering arrows along with small portion of stem. These cut end will be immersed in a vessel containing 0.01% sulphuric acid and 0.01% phosphoric acid. The cut end at the lab is brought nearer and effect cross pollination. They absorb the weak acids. We have to add weak solution daily to replace the acid taken by stem. Once in a week we have to completely change the solution. This is done for 20-30 days. During this time, the seed will mature.

In modified method of this, the female plant alone is cut and kept in weak acid at the time of flowering the male parent can be brought nearer and the pollen can be shed by shaking as done in Lantern method.

Emasculation and Pollination Techniques in Cotton

Selfing

In the selfing of cross-pollinated species, it is essential that the flower are bagged or otherwise protected to prevent natural cross-pollination. Selfing and crossing are essential in crop breeding. It is important that the breeder, master these techniques in order to manipulate the pollination according to his needs. The exact procedure that he may use to ensure self or cross pollination of specific plants will depend on the particular species with which he is working. The structure of the flowers in the species determine manner of pollination. For these reasons, the breeder should acquaint himself with the **flowering habit** of the crop.



In the case of wheat, rice, barely, groundnut etc., the plant is permitted to have self pollination and the seeds are harvested. It is necessary to know the mode of pollination. If the extent of natural cross pollination is more, then the flowers should be protected by bagging. This will prevent the foreign pollen to reach the stigma. Seed set is frequently reduced in ear heads enclosed in bags because of excessive temperature and humidity inside the bags. In crops like cotton which have larger flowers the petals may fold down the sexual organs and fasten, there by pollen and pollen carrying insects may be excluded.

In certain legumes which are almost insect pollinated, the plants may be caged to prevent the insect pollination. In maize, a paper bag is placed over the tassel to collect pollen and the cob is bagged to protect from foreign pollen. The pollen collected from the **tassel** is transferred to the cob.

Emasculation

Removal of stamens or anthers or killing the pollen of a flower without the female reproductive organ is known as emasculation. In bisexual flowers, emasculation is essential to prevent of self-pollination. In monoecious plants, male flowers are removed. (castor, coconut) or male inflorescence is removed (maize). In species with large flowers e.g. (cotton, pulses) hand emasculation is accurate and it is adequate.

Methods of Emasculation

1. Hand Emasculation

In species with large flowers, removal of anthers is possible with the help of forceps. It is done before anther dehiscence. It is generally done between 4 and 6 PM one day before anthers dehisce. It is always desirable to remove other young flowers located close to the emasculated flower to avoid confusion. The corolla of the selected flower is opened with the help of forceps and the anthers are carefully removed with the help of forceps. Sometimes corolla may be totally removed along with **epipetalous stamens** e.g. gingelly.

In cereals, one third of the empty glumes will be clipped off with scissors to expose anthers. In wheat and oats, the florets are retained after removing the anthers without damaging the spikelets. In all cases, gynoecium should not be injured. An efficient emasculation technique should prevent self pollination and produce high percentage of seed set on cross pollination.

2. Suction Method

It is useful in species with small flowers. Emasculation is done in the morning immediately after the flowers open. A thin rubber or a glass tube attached to a suction hose is used to suck the anthers from the flowers. The amount of suction used is very important which should be sufficient to suck the pollen and anthers but not gynoecium. In this method considerable self-pollination, upto 10% is like to occur. Washing the stigma with a jet of water may help in reducing self-pollination; however self pollination can not be eliminated in this method.

3. Hot Water Treatment

Pollen grains are more sensitive than female reproductive organs to both genetic and environmental factors. In case of hot water emasculation, the temperature of water and duration of treatment vary from crop to crop. It is determined for every species. For sorghum 42-48°C for 10 minutes is found to be suitable. In the case of rice, 10 minutes treatments with 40-44°C is adequate. Treatment is given before the anthers dehiscence and prior to the opening of the flower. Hot water is generally carried in thermos flask and whole inflorescence is immersed in hot water.

4. Alcohol Treatment

It is not commonly used. The method consists of immersing the inflorescence in alcohol of suitable concentration for a brief period followed by rinsing with water. In Lucerne the

inflorescence immersed in 57% alcohol for 10 seconds was highly effective. It is a better method of emasculation than the suction method.

5. Cold Treatment

Cold treatment like hot water treatment kills the pollen grains without damaging the gynoecium. In the case of rice, treatment with cold water at 0.6°C kills the pollen grains without affecting the gynoecium. This is less effective than hot water treatment.

6. Genetic Emasculation

Genetic/ cytoplasmic male sterility may be used to eliminate the process of emasculation. This is useful in the commercial production of hybrids in maize, sorghum, pearl millet, onion, cotton and rice etc.,

In many species of self-incompatible cases, also emasculation is not necessary, because self-fertilization will not take place. Protogyny will also facilitate crossing without emasculation (e.g.) Cumbu.

7. Use of Gametocide

Also known as chemical hybridizing agents (CHA) chemicals which selectively kill the male gamete without affecting the female gamete. eg. Ethrel, Sodium methyl arsenate, Zinc methyl arsenate in rice, Maleic hydrazide for cotton and wheat.

Bagging

Immediately after emasculation the flower or inflorescence is enclosed with suitable bags of appropriate size to prevent random cross-pollination.



rice,
size

Pollination

The pollen grains collected from a desired male parent should be transferred to the emasculated flower. This is normally done in the morning hours during anthesis. The flowers are bagged immediately after artificial crossing.



Tagging



The flowers are tagged just after bagging. They are attached to the inflorescence or to the flower with the help of a thread. The following may be recorded on the tag with pencil.

1. Date of emasculation
2. Date of pollination
3. Parentage
4. No. of flowers emasculate