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Emasculation and Pollination Techniques

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Emasculation

The removal of stamens or anthers or killing the pollen grains of a flower without affecting in anyway the female reproductive organ is known as emasculation. The purpose of emasculation is to prevent self-fertilization in the flowers of the line/variety to be used as the female parent. In dioecious plants, male flowers are removed, while in monocious species the male flowers, e.g in Castor, or the male inflorescence, e.g., in maize, are removed to prevent self-pollination. But emasculation is essential in bisexual flowers. It may be done in any one of several ways. The methods suitable for a species is largely determined by the size of its flowers, the amount of seed needed, the number of seeds set per fruit and the purpose for which the hybrid seeds are required. An efficient emasculation techniques should prevent self-pollination and result in a high percentage of seed set on pollination of the emasculated flowers. The efficiency of emasculation techniques may be tested by bagging the emasculated flowers without pollination. The amount of seed thus set would indicate the frequency of chance self-pollination during emasculation.

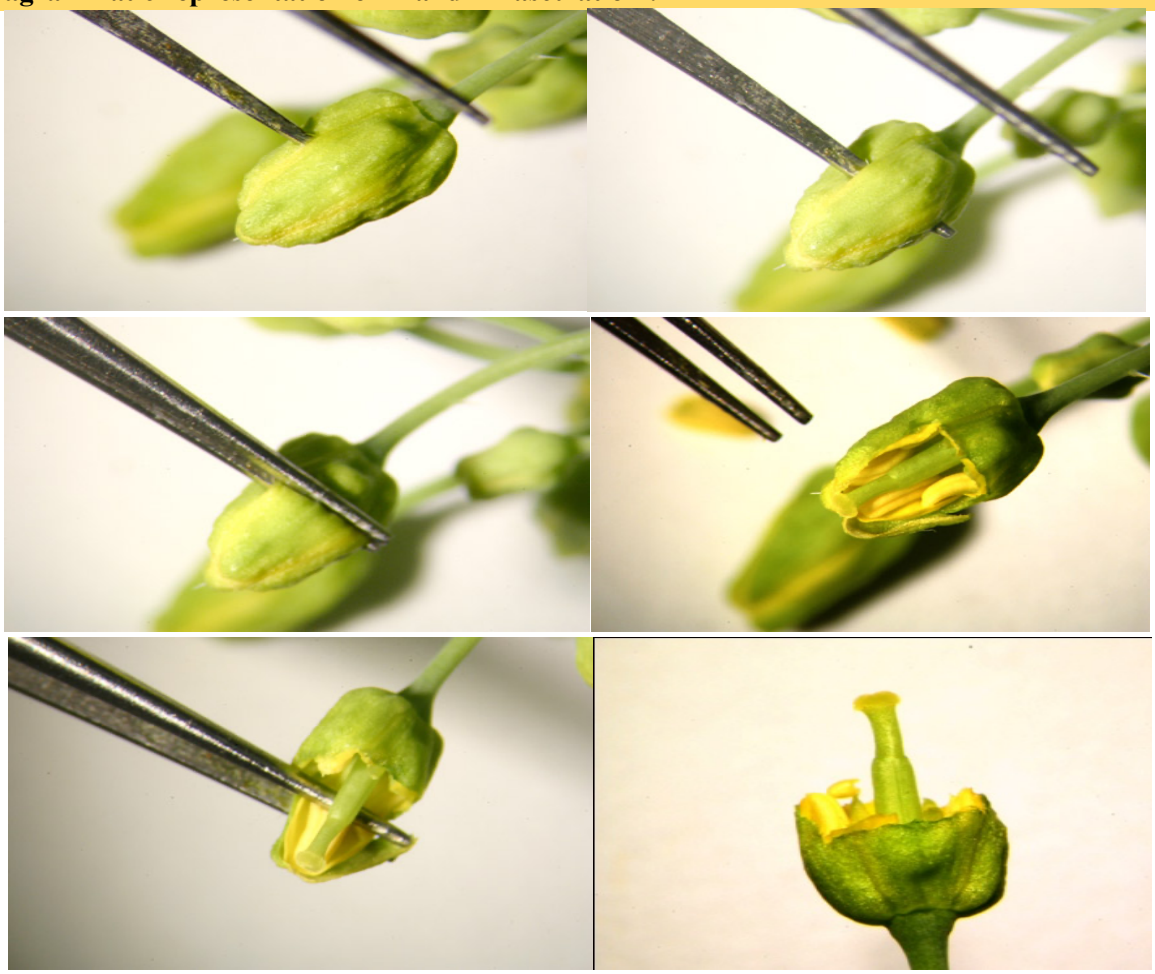
Methods of Emasculation

1. Hand Emasculation

In this, the corolla of the selected flower is opened & the anther are carefully removed with the help of fine-tip forceps. In many crop species the androecium is epipetalous, e.g., in cotton, jute, brinjal, sweet potato, tomato, potato, bhindi, etc. in such cases, sometimes corolla may be totally removed along with epipetalous stamens. In cereals one-third of the empty glumes may be clipped off with scissors to expore the anthers. In wheat (T. aestivam) and oats (A. sativa), only two large florets per spikelet are left, the other floret are removed.

Emasculation is done before the anther are mature and the stigma has become receptive, usually stigma has receptive is at peak during morning hour, when the flower opens. Therefore, emasculation is done generally in the evening. E.g., between 4-6 pm, one day before the anther is expected dehisce or mature and the stigma likely to become fully receptive. Therefore the flowers selected for emasculation are those that are likely to open the next morning. Care must be taken to be removing anther from the flower without damage the stigmas and the ovary. Immediately after the emasculation the flower and the inflorescence are enclosed in suitable bags of appropriate size to prevent random cross pollination. The bags may be paper, butter paper bag, glassine or fine cloth bag. Butter paper and vegetable parchment bags are most commonly used. The bags are tied to the base of inflorescence or the stalk of the flower with the help of thread, wire or pins desired for this purpose. The bags are removed 3-4 after pollination.

Diagrammatic representation of Hand Emasculation :



2. Suction Method

It is useful in species with small flowers. Emasculation is done in the morning immediately after the flowers open. Petals are generally removed with forcep exposing the anther and the stigma. A thin rubber or a glass tube attached to a suction house 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 15% 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^{0}C for 10 minutes is found to be suitable. In the case of rice, 10 minutes treatments with 40-44^{O}C is adequate. Hot water treatment is given before the anthers dehiscence and prior to the opening of the flowers. Hot water is generally carried in thermos flask and whole inflorescence is immersed in hot water. Emasculation with hot water is generally effective in killing all the pollens grains provided the correct temperature and treatment duration are used.

4. Alcohol Treatment

It is not commonly used method of emasculation. The method consists of immersing the flower or the inflorescence in alcohol of suitable concentration for a brief period followed by rinsing with water. In sweet clover, the inflorescence immersed in 57% alcohol for 10 second was highly effective; the percentage of selfing was only 0.89. It is better method of emasculation than suction method. However, the duration of treatment is of utmost importance. Even a slightly prolonged period of treatment, say a few second more than the recommended, would greatly reduce seed set. This is because the female reproductive organs would also be killed by a longer treatment.

5. Cold Treatment

Cold treatment like hot water treatment kills the pollen grains without damaging gynoecium. In the case of rice, treatment with cold water 0-6^{0}C kills the pollen grains without affecting the gynoecium. Keeping wheat plants at 0-2^0 C for 15-24 hours kills the pollen grains. This is less effective than hot water treatment. The amount of self-pollination is generally greater in cold treatment than that in case of hot water treatment.

6. Genetic Emasculation

Genetic or cytoplasmic male sterility may be used to eliminate the process of emasculation. Many species are self-incompatible. In such cases, emasculation is not necessary because self-fertilization will not take place. In certain genotypes and under certain enviorments, the male sterility and self-incompatibility systems may breakdown partially. 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.

Bagging

Immediately after emasculation, the flowers or inflorescence are enclosed with suitable bags of appropriate size to prevent random cross-pollination. In cross-pollination crops, like maize, the male flowers are also bagged to maintain the purity of pollen used for pollination. The bags are may be made of paper, butter paper, glassine or fine cloth. Butter paper or vegetable parchment bags are the most commonly used. Cloth bags are generally not

preferred since they permit some degree of chance cross-pollination. The bags are tied to the base of inflorescence or the stalk of the flower with the help of thread, wire or pins desired for this purpose. The moisture and temperature are generally higher inside the bags as compared to the outside. Therefore, bagging may promotes fungus development on the fruits or the spikes. The bags are removed 3-4 after pollination.

Tagging

The emasculated flowers are tagged just after bagging. Tags are available in different sizes. In most of crops, circular tags of about 3 cm diameter, or rectangular tags 3 X 2 cm are used. In crops like maize, bajra, jowars bigger tags (6 X 3cm) are used. The tags are attached to the flower or 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. No. of flowers emasculated.
4. Name of the female & male parent.

Pollination

In pollination, mature, fertile and viable pollen are collected from freshly dehiscence anthers of the male parent and dusting this pollen on the stigma of emasculated flowers. The duration of pollen viability after anther dehiscence vary greatly from one species to another. Therefore, fresh pollen from mature anthers should be used for pollination. Pollination may be done in one of the following ways :

1. Pollen grains are collected in a bag, and are used for dusting the stigmas of female inflorescence, e.g., in maize, bajra, etc., or of emasculated flowers.
2. Mature anthers are collected from the flowers of male parents. The pollen is liberated and applied to the stigmas with the help of camel hair brush, piece of paper, tooth pick or forceps.
3. Anthers are collected and allowed to burst directly over the stigma. In rice, oats, wheat and barley, one another is generally inserted into each floret where it dehisces and cover the stigma with pollen grains.
4. The spike of male inflorescence is shaken over the emasculated inflorescence just when the anthers are about to dehisce. As a result, the exposed stigma is covered with pollen. This is commonly done in wheat and barley where the lemma and palea are clipped off to expose the stigmas of emasculated flowers.

Conclusion

Emasculation and pollination is a basic technique of hybrid production. This is being from past years. This is the most promising classic and manual technique used by breeders. The probability of human error is very low in hand emasculation and pollination.