## **BREEDING OF FRUIT CROPS**

HFS-504, 3(2+1)

## **Practical Manual**



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#### **Syllabus: Breeding of Fruit Crops, HFS-504, 3(2+1)**

Date:

**Practical:** Exercises on bearing habit, floral biology. Pollen viability and fertility studies. Hands on practices in hybridization. Raising and handling of hybrid progenies. Evaluation of biometrical traits and quality traits. Screening for resistance against abiotic stresses. Developing breeding programme for specific traits. Visit to research stations working on fruit breeding.

Name of Students:				
Roll No	Ba	atch		
Session	. Semester			
Course Name				
Course No:	Credit:			
	Certificate			
This is to certify that Shri./Km				
ID No:	has	completed the	practica	1 of
courses			courses	No
	as per the syllabus	of M. Sc (Horti	culture) I	∃ruit
Science		semester	in	year
in the re	espective lab/field of	college.		

**Course Teacher** 

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S. No	Name of Exercise	Signature
1.	To identify and uses of Plant Breeders Kits	
2.	To learn the method of colchicines treatment in order to induce polyploidy in fruit crops.	
3.	To learn the method of application of EMS in seeds for mutation	
4.	To study about floral biology of Mango	
5.	To study about floral biology and different cultivars of Banana	
6.	To study about floral biology of Sapota	
7.	To learn about pollen viability test in different fruit crops	
8.	To know the procedure of emasculation and pollination of flower for making artificial crosses.	
9.	To study and practice of crossing technique in major fruit crops	
10.	To study about floral biology of different species of Citrus	
11.	To study about floral biology and hand pollination of Custard Apple	
12.	To study about different sex forms of papaya	
13.	To study the breeding approaches for drought resistance	
14.	To study the important fruit varieties developed through conventional breeding methods	
15.	To study the estimation of variability parameters	
16.	To visit to biotechnology lab and in vitro study of breeding technique	

## Objective: To identify and uses of Plant Breeders Kits

A breeder wants the following tools for controlled breeding regarding work and for field observation purpose.

S. No	Name of the kits	Uses
1.	Fine pointed forceps:	
2.	Small/ curved scissor:	
3.	Long straight scissor:	
4.	Needle:	
5.	Sharp pointer:	
6.	Magnifying lens:	

7.	U-pins (u- clips):
8.	Paint brush:
9.	Pencil:
10.	Washing bottle or Spirit bottle:
11.	Wire ring and smooth thread:
12.	Small white tag:
13.	Soda straw tubes:
14.	Waxy threads:

15.	Luggage labels (white or yellow):
16.	Aluminum label with wire:
17.	Muslin cloth bag (large size):
18.	Yellow sample bag:
19.	Paper Bag:
20.	Kite paper bag (white/red):
21.	Field Notebook:

**Assignment:** List the various apparatus of breeder's kit and write its uses.

# Objective: To learn the method of colchicines treatment in order to induce polyploidy in fruit crops.

Plants having more than two sets of chromosomes are referred as polyploids. Autopolyploids can be induced by chemical mutagen like acenaphthene, colchicines, caumarin etc. The colchicines is most widely used for chromosome doubling. Colchicines inhibit the formation of spindles fibre during metaphase. As a result, karyokinensis does not occur and the chromosome number of treated cells gets doubled.

Material required:
Procedure:

Seed treatment:		
Shoot apex:		
01 4 10 11 1		
<b>Observations:</b> 10 seedlings shou		
	Morphological characters treated plants	Morphological characters untreated plants
Seed treatment	•	•
Seedling treatment		
Short apex treatment		

The observation for polyploidy to be recorded throughout the semester

Objective: To learn the method of application of EMS in seeds for mutation
Among the chemical mutagens, the Ethylmethane sulphonate (EMS) is frequently used for
induction of mutation.
Material required:
Procedure:
Observation: 10 treated and 10 untreated condlines to be transmissed for recording absenuation
<b>Observation:</b> 10 treated and 10 untreated seedlings to be transplanted for recording observation <b>1. Percentage of germination</b>
Untreated
Treated
ALVIIVA

#### **2. Morphological characters** (after 90 days)

		Seedling number									
		1	2	3	4	5	6	7	8	9	10
Height	Untreated										
	Treated										
Girth	Untreated										
	Treated										
Leaf area	Untreated										
	Treated										
Internodal length	Untreated										
	Treated										

#### 3. Floral character

			Seedling number								
		1	2	3	4	5	6	7	8	9	10
Height of 1 <sup>st</sup> flowering	Untreated										
	Treated										
Sex of flower	Untreated										
	Treated										
Sessile on with pedicel	Untreated										
	Treated										

#### Objective: To study about floral biology of Mango

Floral biology is the study of flowers, which includes opening of flower (anthesis), dehiscence of anthers, pollen viability and stigma receptivity. This information is essentially required for any hybridization programme. Usually, anthesis of flowers takes place in the morning in most of the crops. Anther dehiscence takes place few hours before or after anthesis. Mango panicles contain male and hermaphrodite flowers. The percentage of hermaphrodite flowers varies from 1.25-8.10.

Material required:

6.10.
Material required:
Procedure:
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Observat	ion: Ti	me of anthesis	s (out o	f 10 selected f	flowers	s)						
		Time										
		7.00 am		8.00 am 9.00 am				10.00 am				
	Male	Hermaphrodite	Male	Hermaphrodite	Male	Hermaphrodite	Male	Hermaphrodite				
No of flower												
Percentage of flowers opened												
Time of d	ehiscen	ice (out of 10	selecte	d flowers)		L		l				
				r	Time							
		7.00 am		8.00 am	9.00 am			10.00 am				
No of flower												

I						
	Percentage of flowers opened					
•						
•						
•		 				

#### Objective: To study about floral biology and different cultivars of Banana

Banana breeding was started in Trinidad, West Indies in 1922 and in Jamaica in 1924 (Shepherd, 1994). The driving force for this breeding programme was to develop improved Fusarium wilt (Fusarium oxsyorum F.sp. Cubense) resistant banana for trade. In 1960, both the programmes were combined under the Jamaica Banana Board. United Fruit Company also started a small breeding programme in Panama in 1920s. In India hybridization work was started at Central Banana Research Station, Adhuthurai, Tamil Nadu in 1949. Edible banana is native to old world especially South East Asia (Simmonds, 1962). Malayan area seems to be the primary centre of origin of cultivated banana (M.acuminata). M.acuminata, was probably introduced into India and Burma where M balbisiana is a native species. Natural hybridization between these two species might

have resulted in many hybrid progenies (AAB, ABB etc).  Material required:
Waterial Tequired.
Floral biology, anthesis and pollination:

Cultivar Details:

Draw well-labelled diagram	

Objective: To study about floral biology of Sapota  Material required:	
Material Tequired:	•••
	•••
	• • •
Floral biology, anthesis and pollination:	
	•••
	• • •
	• • •
	• • •
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	•••
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## **Qualitative Observations: Qualitative characters** Description 1. Corolla colour Calyx colour 2. Anther colour 3. Stigma colour 4. Position of ovary 5. **Qualitative observations:** S No **Qualitative characters** Average Number of petals 1. 2. Number of stamens Number of sepals 3. Length of pistils 4. Length of stamen 5. Draw well labeled diagram of Sapota flower and its parts

## Objective: To learn about pollen viability test in different fruit crops

Flowers produces a large number of pollen grains. However, all the pollens are not viable and fail to germinate on the stigma, which may result in failure of fruit set.  Material required:		
<del>-</del>		
Preparation of acetocarmine:		
Procedure for pollen viability test in acetocarmine:		

The pollen viability percentage at any given time after dehiscence of anthers work out as

Pollen viability 
$$\% = \frac{\text{No of stained pollen grain}}{\text{Total number of pollen grain}} \times 100$$

#### **Observation:**

Crop	Test	Stained pollen (No)	Unstained pollen (No)	Pollen Viability

# Objective: To know the procedure of emasculation and pollination of flower for making artificial crosses. In order to make cross of two parents, the emasculation and pollination of flowers is required.

Emasculation is removal of anthers, and the supply of pollen grain on the stigma for fertilization				
is called pollination. The seeds formed after pollination is called hybrid				
Material required:				
Procedure of emasculation:				

#### **Observation: Record the number of fruit set**

Date	Female parent	Male Parent	Date of pollination	Fruit set (Yes/No)
			1	

<b>Objective:</b> To study and practice of crossing technique in major fruit crops Hybridization refers to mating or crossing of two plants or lines of diverse genotypes to obtain a viable hybrid progeny. The seed as well as the progeny resulting from hybridization are known as 'hybrid' or F1. <b>Crossing techniques:</b>
Material required:
Hybridization Technique:
Selection of parents:
Evaluation of parents:
Emasculation:
Bagging:

Tagging:	
Pollination:	

#### Objective: To study about floral biology of different species of Citrus

Citrus flowers are large, hermaphrodite, borne solitary and have numerous stamens present in many whorls. Lime and lemons have staminate flowers also. For hybridization, parents with complimentary characters are selected. The mature flower buds on the female parent are emasculated early in the morning on the day of opening and are bagged.

The flowers to be used as male parent are bagged the previous day evening and the next morning as the day warms up, the anthers dehisce releasing the pollen grains when these flowers can be plucked to pollinate the receptive stigmas or emasculated flowers. The pollinated flowers are bagged, opened after about a week and allowed to mature into ripe fruits. In some cases, especially when the trifoliate orange is used as male parent, difficulties are encountered as its flowering is over before other citrus varieties flower. Therefore, pollen has to be stored at low humidity and temperature

Motorial required.
Material required:
Floral biology, anthesis and pollination:

## Qualitative observation

S. No	<b>Qualitative characters</b>	Description
1.	Petal (present/absent)	
2.	Calyx colour	
3.	Anther colour	
4.	Stigma colour	
5.	Position of ovary	
Qualit	ative observation	
S. No	<b>Qualitative characters</b>	Average
1.	Number of stamens	
2.	Number of sepals	
3.	Length of pistils	
4.	Length of stamen	
Draw w	vell labeled diagram of citrus f	lower and its parts

Objective: To study about floral biology and hand pollination of Custare Apple Material required:
Waterial required.
Floral biology, anthesis and pollination:
Hand Pollination procedure
Hand Pollination procedure:

				•••••	
				•••••	
Obser	vation: Record t	the number of f	fruit set		
Date	Female parent	Male Parent	Date of pollination	Fruit set (Yes/No)	Fruit Shape

# Objective: To study about different sex forms of papaya Papaya is a polygamous species; many forms of inflorescence have been reported. In general,

there are three types of flowers namely staminate, pistillate and hermaphrodite. Staminate flower is produced by male plant, while teratological staminate flower is produced by s reversing male plants. Pistillate flower is produced by female plants. Elongata, reduced elongate carpelloid elongata, pentandria and carpelloid pentandria are normally produced hermaphrodite plants. According to Storey (1958), there are 15 comparable classes found in maplants as well as in hermaphrodite plants. There are 32 heritable sex forms in papaya. Cultivate papayas belong to two major sex forms.  Material required:			
Floral biology, anthesis and pollination:			

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Assignment: Draw well labelled diagram

#### Objective: To study the breeding approaches for drought resistance

To advance crop at genetic level, plant breeders are usually more concerned in the practice of intra specific variation, simply useable without any genetic barriers. Intra-specific crosses follow normal Mendelian segregation and selection of F2 at future generations to identify the suitable pant progenies including pure lines. Many breeding methods like mass selection, pure line recurrent selection, methods can be applied, in stress or non-stress conditions besides some other methods like in-vitro selection and usage of soma clonal variations can also be employed.

1. Mass Selection:
2. Pure Line Selection:
3. Recurrent Selection:

4. Manipulation of Somaclonal Variation:
Ducklama in duamakt maistanaa kusadina.
Problems in draught resistance breeding:

# Objective: To study the important fruit varieties developed through conventional breeding methods

Fruit breeding is involved with the development of new cultivars that are suited to specific environmental and production practices, as well as to fulfil food, fibre and feed requirements. Fruit breeding refers to the process of improving the genetics of fruit crops by diverse approaches such as selection, hybridization, mutation, induction, and molecular techniques.

List of promising varieties of fruit crops with their important traits

Fruit crops	Variety	with their important traits  Breeding methods	Important trait
Mango			

i <del></del>	 	
Grape		
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Domores		
Papaya		
Guava		
Pomegranate		
Foillegranate		

Apple		
Citrus		

#### **Objective:** To study the estimation of variability parameters

Variability means a difference among the individuals belonging to a single species or different species within a population. The variability may be due to genotypes. environments or due to the interaction of genotype x environment. There are two basic types of variability. Genotypic variability and phenotypic variability.

- **1. Genotypic variability:** It is the component of variability which is due to genetic differences among the individuals within a population. It is the main concern of the plant breeders.
- **2. Phenotypic variability:** It is the observable total variation present in a character of a population. It includes both genotypic and environmental components of variability and as a result, its magnitude differs under different environmental conditions.

Thus, total variability (phenotypic variability) can be partitioned into following components of variability as under:

 $P = G \times E$ 

Vhere,
P: Phenotypic variance,
G=Genotypic variance,
E=Environmental variance
mportance of genetic variability in Fruit breeding:

Estimation of genetic Variability, Heritability and Genetic Advance:	
The genetic variability present in breeding populations can be assessed by three ways	
✓ By using simple measure of variability:	
✓ By estimating the various components of variance:	
by estimating the various components of variance.	
✓ By studying the genetic diversity within a population:	

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Define/Eplain Vorichility
Variability:
Heritability:
Standard Error:
Coefficient of variation:

Objective: To visit to biotechnology lab and in vitro study of breeding technique