

**CHAPTER 9**

# STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

## Topics Discussed

INTRODUCTION

ANIMAL HUSBANDRY, POULTRY FARMING,

APICULTURE AND FISHERIES

ANIMAL DISEASES

PLANT BREEDING

BIOFORTIFICATION

SINGLE CELL PROTEIN

TISSUE CULTURE

PLANT DISEASES

## 1. Introduction

- Man has grown crops and reared animals for his benefit since times immemorial.
- In some cases this has eased the life of the humans while in some cases it was an absolute necessity.
- It should be noted that the initial activities in this direction did not lay much focus on 'increasing the yield'. They were focused on 'getting the yield'.
- The population of the world has greatly increased in the last few centuries.
- The quality and quantity of goods required/ demanded by this population has also risen steeply.
- To meet these demands it is necessary to develop and implement technologies and practices that will maximize the yield from the existing resources.

## Objectives

At the end of this chapter, you will be able to:

- To learn about the concept and various types of animal husbandry.
- To learn about animal diseases and some approaches to cure and prevent them.
- To learn about the use of genetics to develop newer more useful varieties of existing plants/animals.
- To learn about the techniques of plant tissue culture.
- To learn about plant diseases.

## 2. Animal Husbandry

- It is the rearing of animals by man for profit.
- Commonly reared animals include livestock like cows, buffaloes, pigs, horses, cattle, sheep, camels, goats, etc. It also includes poultry farming and fishery.
- Fisheries include rearing, catching and selling of fish, molluscs and crustaceans (prawns, crabs, etc.).
- Estimates predict that more than 70 per cent of the world's livestock population is in India and China.
- However, their contribution to the world's produce is only 25 per cent.
- Thus the productivity per unit is very low.
- Hence, it is essential to think about the adoption usage of new technologies and practices to improve the yield and profitability.



### Did You Know

The term 'husbandry' is related to the word 'husband' meaning the one who takes care.

## Livestock

- Livestock are domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labor.
- E.g. Cattle, buffaloes, sheep, goat, pigs, horses, camel etc.

## Important Factors Necessary to Enhance the Yield from Animals

- Suitable breed.
- Clean shelter.

- Good quality of appropriate food.
- Vaccination and other relevant medical care

## 2.1 Animal Breeding

- Breeding is important from the point of view of increasing the output from animals.
- It allows the breeder to have animals with a desired set of characteristics.

### Inbreeding

- It is breeding between animals of the same breed.
- It is the mating of closely related individuals within the same breed for 4-6 generations.
- The cow or buffalo that yields more milk per lactation is called a superior female. Whereas the bull which gives rise to superior progeny as compared to those of other males is called a superior male. Superior males and superior females of the same breed are identified and mated in pairs.
- The progeny obtained are evaluated and superior males and females among them are marked for further mating.
- Inbreeding increases homozygosity. It is thus used for generating pure lines.
- Inbreeding tends to expose harmful recessive genes. The organisms with these genes can then be taken out of the breeding program.
- Thus inbreeding can help to increase the productivity.
- In some cases continued inbreeding, (especially between closely related individuals) reduces fertility and even productivity. This is called Inbreeding depression.
- As remedy for this is to allow mating with unrelated superior animals of the same breed.

### Out-Breeding

- The breeding of the unrelated animals, which may be between individuals of the same breed having no common ancestors or of different breeds or of different species is called out-breeding.

#### a. Out-Crossing

The practice of mating of animals having no common ancestors on either side of their pedigree up to 4-6 generations within the same breed is called out-crossing. The offspring of such a mating is known as an out-cross. A single outcross often helps to overcome inbreeding depression. It also improves milk productivity and growth.

#### b. Cross-Breeding

Superior males of one breed are mated with superior females of another. Cross-breeding allows the desirable qualities of two different breeds to be combined. The progeny hybrid animals may themselves

be used for commercial production. Alternatively, they may be subjected to some form of inbreeding and selection to develop new stable breeds that may be superior to the existing breeds. Many new animal breeds have been developed by this approach. Hisardale is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Marino rams.

### c. Interspecific Hybridization

A male and female of two different species are mated. In some cases, the progeny may combine desirable features of both the parents, and may be of considerable economic value, E.g., Mules (Offspring of a male donkey and a female horse) are sturdier and hardier than their parental species.

## 2.2 Cows (*Bos indicus*) and Buffaloes (*Bubalus*)

Cattle like cows and buffaloes are widely used for-

- **Agricultural Operations**

For pulling carts and wagons.

For agriculture operations like ploughing, harrowing, levelling etc.

- **Milk**

Milk which is an important foodstuff is provided by the cattle.

- **Transport**

For driving carts for transportation.

- **Manure**

The dung excreted out by cattle can be used as manure.

- **Fuel**

The dung can be used as fuel in the form of dung-cakes and for the production of biogas.

- **Leather**

Their skin can be processed for use in manufacture of leather goods.

- **Glue and gelatin**

Glue and gelatin can be obtained from their bones, horns and hoofs.

- **Meat**

Meat from buffaloes is consumed by some people.

### Breeds of Buffaloes

*Bubalus bubalis* is called water buffalo. Some of the common breeds in India are- Jaffrabadi, Surti, Nagpuri (ellichpuri), Bandawari, Niliravi, Murrah, Mehsana.

### Breeds of cows

Important breeds reared from the point of view of obtaining milk are Jersey, Holstein, Guernsey, Brown Swiss, Red Dane, Ayrshire etc.

### Feeding/Nutrition

- To get optimum output, be it milk or be it physical labor, it is of utmost importance to provide the cattle with food that contains appropriate proportions of carbohydrates, proteins, fats, vitamins minerals and water.
- Feed has two main components- **Roughage and Concentrate**  
**Roughage** has large amount of fibres. It includes silage (a form of fermented fodder) and hay fibre. The **concentrate** is a mixture of rice polish, cereal broken grams, cotton seeds, gram bran and oil cake moistened in water.
- Low purity of fodder is responsible for the lesser milk production in India.
- Productivity is also affected by underfeeding or overfeeding the cattle.

### Breeding

- Hybrid cows tend to yield more milk and hybrid oxen may be stronger. Gestation (carrying of embryo/ fetus inside the body) period of cows is about 9 months and buffaloes is about 10 months.
- The breeding of cattle is done by two methods
  - a. Natural Breeding.
  - b. Artificial breeding.

#### a. Natural Breeding

In this type of breeding the male and the female actually mate with each other.

It is of two types-

##### 1. Random Breeding

Some pedigree bulls are introduced in the herd. Bulls not selected for mating are castrated.

##### 2. Controlled Breeding

The males and females are separated into different groups before attaining puberty. This ensures undesirable mating. Superior quality bulls are then introduced into the herd and allowed to mate with native cows. E.g. Jersey Sindhi breed, Ayrshire Sahiwal breed etc.

#### b. Artificial Breeding

Bull semen is introduced into the reproductive tracts of cows. Actual mating does not take place. The advantage is that a single bull can be used to inseminate multiple cows. The semen may be used immediately or can be frozen and used at a later date. It can also be transported in a frozen form to where the female is housed. Sometimes a male from a non-related male is not accepted in a herd and the female and/or male may not mate with each other naturally. These difficulties are overcome by artificial breeding.

Cows are injected with FSH like hormones and induced to produce 6-8 ovaries instead of the normal one. These cows are then mated/inseminated and the fertilized embryos are removed and transplanted into other cows. The superior breed female which was earlier used can be used for one more round of the above process after a short period of life.

### 2.3 Sheep (*Ovis aries*)

- Sheep are reared for their wool and meat.
- They live for about 13 years.
- They feed on grass and herbs.

#### Breeding of Sheep

- Sheep can engage in reproduction after two years of age.
- Generally cross breeding is preferred.

#### Breeds

- Deccani and Nellore breeds are raised only for mutton.
- Patanwadi provides wool for army hosiery
- Narwari yields coarse wool

#### DID YOU KNOW

##### Some breeds of Indian sheep and their specialities

**Table 9.1:** Breeds of Indian Sheep

Breed	Use
• Lohi	Milk, good quality wool
• Rampur-Bashair	Superior cloth, Brown colour fleece
• Nali	Superior carpet wool
• Bhakarwal	Undercoat used for high quality Shawl
• Deccani	Mutton, no wool
• Nellore	Mutton, no wool
• Narwari	Coarse wool
• Patanwadi	Wool for army hosiery



## 2.4 Goat (*Capra*)

- Goats feed on a variety of wild plants even prickly ones.
- It also yields a little amount of milk.
- It is also called poor man's cow.
- Goat skin was used as water and wine containers in historic times.
- Goat skin was also used as parchment for writing.

### Breeding of Goats

- A male adult (bully goat) is bred with a female adult (nanny goat or doe).
- The offspring are called kids.

#### DID YOU KNOW

##### Some Indian goat breeds

Table 9.2: Breeds of Indian Goat

Some Goat Breeds	Breeds Distribution
1. Gaddi	Himachal Pradesh
2. Kashmiri Pashmina	Hills of Kashmir, Tibet, HP
3. Jamunapur	UP,MP
4. Beetal	Punjab
5. Marwari	Rajasthan
6. Besari	Maharashtra
7. Malabari	Kerla
8. Bengla	Bihar, Orissa

## 2.5 Some Other Animals

### Yak (*Poephagus grunnies*)

It is reared in mountainous regions for meat, wool, hide, milk, transport and tilling.

### Pig (*Sus*)

- Pig is the most economical source of meat for human beings. Its meat is called pork.
- Pig fat is used as cooking medium and for preparation of soap.

- Pig hide can be used for leather production
- Pig hair can be used for making brushes.
- Pigs are susceptible to extreme heat and cold. Domesticated pigs are also called swine.
- Pigs can have an excellent sense of smell.
- Some varieties of pigs are kept as pets while some are even hunted.

### Feeding of Pigs

- Non-domesticated pigs generally feed on garbage and kitchen waste.
- As pigs can feed on human feces they can be carriers of tapeworms.
- Domesticated pigs are fed with grass, soya meal etc. enhanced with some vitamins and other nutrients.

### Breeding

Pig breeding has now started on commercial scale in India.

### Indigenous pigs in India

Deshi, Gahori etc.

### Exotic Pigs

Berkshire, Large white Yorkshire, Landrace etc.

### Camels

- It is known as the ship of the desert.
- Camels are commonly for transport in deserts.
- Milk is also obtained from them.
- Their hair is used to make bristles in brushes.
- Camels have strongly adapted to 'desert life'.
- They can store food and water in their bodies in significant quantities and can survive without the same for about 10 days.



#### TRY IT YOURSELF

1. Best source for dietary protein for a vegetarian is
 

(1) Soy Bean	(2) Gram	(3) Groundnut	(4) Milk
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2. The number of cattle breeds in India is
 

(1) 5	(2) 18	(3) 26	(4) 36
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### 3. Poultry Farming

- Poultry farming is the rearing of domesticated birds like fowl, chicken and ducks, turkey and geese.
- Birds contain more protein compared to fats.
- Eggs laid by some birds are also consumed.
- Poultry farming requires less space and investment.
- The birds are fed with cereals, millets oil cakes, fish and meat meal, minerals and green vegetables, fish silage, protein concentrate etc.

#### 3.1 Hens

- One of the most common poultry animals is the hen.
- It starts laying eggs after 6 months.
- Indian hens lay about 60 eggs/year. The exotic breeds lay about 260/year.
- Birds raised for meat are called broilers.

#### 3.2 Ducks

- Ducks are close relatives of swans and geese.
- They are reared for eggs and also are hunted.
- They feed on some specific aquatic animals and plants.

#### 3.3 Common Diseases of Poultry

Some of the commonly occurring disease of poultry are as follows

- **Viral Diseases**  
Fowlpox, bird flu, bronchitis and Ranikhet (Newcastle) disease are common viral diseases of poultry.
- **Bacterial Diseases**  
Fowl cholera, pullorum, coryza, mycoplasmosis and spirochaetosis.
- **Fungal diseases**  
Aflatoxicosis, aspergillosis and thrush.
- **Parasitic diseases**  
Internal Parasites – Round worms, tapeworms and threadworms.  
External parasites – Fowlmite, chickenmite, fleas, ticks etc.



#### KNOWLEDGE BUILDER

- The Newcastle disease virus (NDV) can infect humans causing mild flu.
- NDV has shown some tendency to preferentially infect tumor cells. Thus it is also used in anti-cancer research.
- Sometimes the best solution to some poultry diseases is to destroy the affected population.



#### TRY IT YOURSELF

1. What is poultry farming?
2. Name a few diseases of poultry.

## 4. Apiculture

- Maintenance of honey bee colonies in hives is called apiculture.
- Apiculture can provide us with honey.
- Bees pollinate our crops (E.g. sunflower) and hence are beneficial for farmers too.
- Bees are social animals and show division of labor in their colonies.
- Other products harvested from the beehive include royal jelly, beeswax, beeglue etc.

### 4.1 Important Species of Honey - Bees

- ***Apis dorsata*** (Rock bee)

It is also named as saarang bee. It is large sized and produces large quantities of honey. But due to its aggressiveness and migratory behavior, it is not suitable for apiculture.

- ***Apis indica*** (Indian Mona-bee)

It yields about 3- 4 kg of honey per hive. It is not aggressive and hence is suitable for apiculture.

- ***Apis florea*** (Bhiringa – bee)

It is small and timid but yields only 250 gm of honey per hive. Hence it is unsuitable for commercial apiculture.

- ***Apis mellifera*** (European bee)

It is mild and produces more honey than Mona-bee. Hence it is important from the point of view of apiculture.

## 4.2 Types of Bees

### 1. Queen bee

- i. It is about 1.5 cm to 2 cm long
- ii. Its body is about three times larger and heavier than a worker bee.
- iii. Its main function being reproduction, it lays 2000 eggs/day.
- iv. It develops from fertilized egg and has 32 chromosomes.
- v. It feeds on royal jelly.

### 2. Drone bees

- i. Their main function is to fertilize the eggs.
- ii. They develop from unfertilized eggs.
- iii. They have only 16 chromosomes.
- iv. There are around 100 drones in a hive.
- v. They are 0.7 cm to 1.5 cm long

### 3. Worker bees

- i. Their function is to collect nectar.
- ii. They have a pollen sac and modified sucking mouthparts.
- iii. They are sterile females which develop from fertilized eggs.
- iv. They also have wax glands.

## 4.3 Modern Apiculture

- Artificial hives are used so that the extracting of products becomes simpler.
- Protective clothing is used to avoid stings. Experienced bee-keepers may not use gloves as they hinder delicate manipulations.
- Smokers are used as defense mechanisms. Smoke calms bees down and also masks the scent of their signaling mechanisms.

## 4.4 Bee Keeping

- It does not require high investment and is not labor intensive.
- The location of an apiary should be near an orchard or a flower garden.
- The person should possess a knowledge of what type of hive can suit the species of the bees he has chosen for apiculture.

- The person should be able to catch a swarm of bees and transfer them into the hive.
- The person should also possess certain skills required to extract honey and other products from the hive.

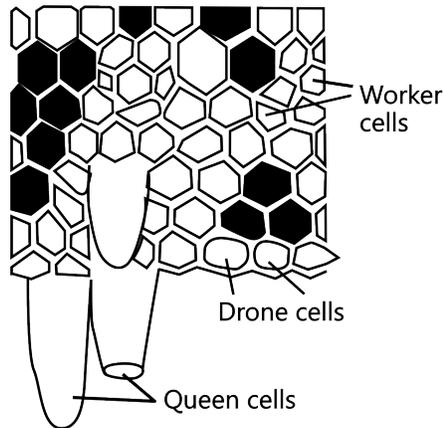


Figure 9.1: Cells in an honey comb

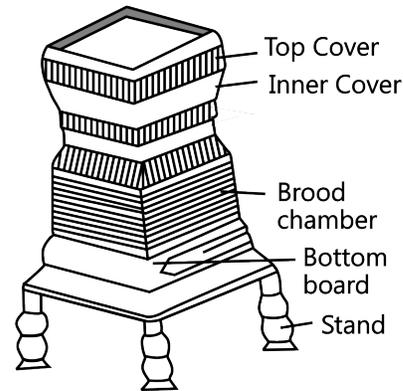


Figure 9.2: An artificial beehive

#### 4.5 Life Processes of Honeybees

- Queen bees lay 2,000 eggs per day which hatch in about 3 days.
- From the 4th day, the babies are fed with honey and pollen by the worker bees.
- From the 7th day royal jelly is secreted by worker bees. Royal jelly is fed to larvae and adult queen bees.
- Beeswax and beeglue/propolis are secreted from the 12th day. Propolis is used by the honey bees to seal unwanted spaces by the bees.
- Drone bees develop from the unfertilised eggs.
- Queen bee grows to adult from egg within about 15-16 days, a drone takes 24 days while a worker takes 18-22 days to mature.

#### Honey Preparation by the bees

- Worker bees collect nectar.
- Nectar is acted upon by salivary and other enzymes.
- A glucose fructose and pollen based substance is stored in the hive.
- This substance is then fanned by bees to remove excess water. This end product is honey.
- The removal of water makes honey less susceptible to the growth of micro-organisms.

#### Communication by Dance

- Honey bees have colour vision.
- They communicate about the direction and distance of the food source by means of certain dancing movements.

- Karl Von Frisch won the Noble Prize in Medicine in 1973 for his work on 'sensory perceptions of honey bees'.
- Waggle dance is used to communicate that the food is far away from the hive.
- Also, the sun is used as a reference for the directions.
- Round dance is used to indicate the location of food sources closer to the hive.
- The dances and their meanings vary from species to species like dialects of humans from different regions.

## 4.6 Commercial Importance of Apiculture

### 1. Honey

- i. It is of high nutritive value
- ii. It has medicinal properties.
- iii. Honey is fermented to produce a beverage called mead.
- iv. Honey was traditionally used as a preservative in some cultures.

#### Composition of Honey-

- |                        |   |                 |
|------------------------|---|-----------------|
| • Water                | - | 17-20%          |
| • Fructose             | - | 40-45%          |
| • Glucose              | - | 32.37%          |
| • Sucrose              | - | 12%             |
| • Enzymes and pigments | - | 2.21%           |
| • Ash                  | - | 1%              |
| • Vitamins             | - | B1, B6, C and D |

### 2. Bee Wax

- It is used in cosmetics.
- Used in shoe polish and furniture polish.
- It is used in some surgeries.

### 3. Bee Glue/Propolis

- It is used for manufacturing some music instruments (varnish for their wooden parts).
- It is used in some chewing gums.
- It is used in the manufacture of car wax.

#### 4. Royal Jelly

- It is used for the manufacture of some food preparations with high nutritive value.
- However some researches show that consumption of royal jelly may not be highly beneficial to humans.



#### TRY IT YOURSELF

1. What is royal jelly?
2. Name two species of bees that are suitable for apiculture.

### 5. Fisheries

A fishery is a group of individuals engaged in catching and/or rearing fishes.

#### 5.1 Some Species of Fishes

##### Freshwater fishes

*Catla catla* (Catla)

*Labeo rohita* (Rohu/Carp)

*Mystus seenghala* (Singhara)

*Cyprinus carpio* (Common carp, Exotic species)

##### Marine Fishes

*Hilsa*

*Eleutheronema* (Salmon)

*Sardinella* (Sardine)

*Harpodon* (Bombay duck)

#### 5.2 Culturing of Fishes

- The fish species which yield good quality and quantity of food are cultured in ponds.
- Generally, more than one species is cultured in the same pond at the same time.
- In India *Catla*, Rohu and Mrigala are stocked in a pond in the ratio 3:3:4.
- This is termed as composite culturing. Understandably, the species should be compatible with each other.

### 5.3 Important Factors Pertaining to Culturing of Fishes

- A suitable site has to be selected for building a tank.
- The tank should have appropriate dimensions to cater to the specific requirements of the species of fish being reared in it.
- The tank walls should be treated with lime to ensure that a conducive pH is maintained.
- The growth of aquatic plankton should be encouraged by addition of appropriate fertilizers. The plankton serves as food for the fishes.
- Growth of harmful weeds should be prevented.

### 5.4 Breeding

- Healthy males and females of the desired species are induced to reproduce by injection of hormones (analogous to FSH or LH or HCG).
- They fertilized eggs are transferred to hatching tanks.
- The hatchlings also called sac fry are then transferred to nursery ponds.
- They grow into a stage called 'fry'. Fry can be fed with artificial food.
- The fingerlings are the next step. They are kept in rearing or raising ponds. This step is called thinning. Where they feed on both natural and artificial food. In rearing ponds, the fingerlings grow upto a size of 15-20 cm long. Now these are transferred into stocking ponds.
- Fingerlings grow upto 20 cm in raising ponds. They are then transferred to stocking ponds.
- They mature into adults in these ponds in 6-9 months. They are then captured with the use of nets or hooks.

### 5.5 Products of the Fishing Industry

- Fish are consumed as food. Marine food is rich in iodine.
- Some fish are kept as pets.
- Isinglass- It is prepared from the swim bladder of some fishes. It is used in gelatin manufacture and clarification of beer.
- Fish oil- It is a vitamin rich substance.
- Fish meal- A calcium rich substance used as fodder for animals.
- Fish protein- Can be used in ice creams, pharmaceuticals, paints, varnishes, textile, paper and cosmetics.
- Fish flour- A nutritive food supplement for infants.
- Fish skin- It has leather-like applications i.e. manufacture of some cases etc.

## 6. Animal Diseases and their Control

### 6.1 Diseases of Animals

Disease and host	Pathogen	Details
<b>Bacterial diseases</b>		
<p><b>Anthrax</b> affects cattle, sheep, goats, horses etc. It can affect humans also.</p>	<i>Bacillus anthracis</i>	<ul style="list-style-type: none"> <li>• Blood mixed secretions from external body openings is seen.</li> <li>• Animals die within 2-3 days of getting infected.</li> <li>• The bacterium affects oxygen carriers in the body. This leads to increased respiratory rate.</li> <li>• Preventive measures include vaccination and injection of antiserum.</li> <li>• Diagnosis is based on detection of the presence of the bacteria in blood.</li> </ul>
<p><b>Bovine TB</b> affects cattle and many other animals. It can affect humans also (rare).</p>	<i>Mycobacterium bovis</i>	<ul style="list-style-type: none"> <li>• The modes of transmission are aerosols and droplets along with milk.</li> <li>• Rifampicin can be used for treatment.</li> <li>• The animals have to be separated from the herd to prevent the spread of the disease.</li> </ul>
<p><b>Botulism</b> affects sheep, poultry and cattle. Affects humans also.</p>	<i>Clostridium botulinum</i>	<ul style="list-style-type: none"> <li>• The disease is caused due to a toxin secreted by the bacteria. This toxin affects the nervous system and causes paralysis.</li> <li>• In cattle, the symptoms may include drooling, restlessness, urine retention,</li> <li>• In sheep, the symptoms may include drooling, nasal discharge, stiffness etc.</li> <li>• A vaccine is available but its usefulness is unclear.</li> <li>• It can spread through honey also.</li> </ul>

		<ul style="list-style-type: none"> <li>• Cooking can destroy the toxin but bacterial spores may survive it.</li> <li>• Anti-serum can be used for treatment.</li> </ul>
<b>Viral diseases</b>		
<p><b>Rinderpest</b> affects cattle.</p> <p>No known record of affecting humans.</p>	<i>Morbillivirus</i> genus.	<ul style="list-style-type: none"> <li>• Symptoms include fever, oral erosions, diarrhoea,</li> <li>• Death rates were extremely high.</li> <li>• After extensive efforts the disease is supposed to be the second disease (after smallpox) to be completely eradicated.</li> </ul>
<p><b>Cowpox</b> affects cattle.</p> <p>It can affect humans.</p>	<i>Orthopoxvirus</i> genus.	<ul style="list-style-type: none"> <li>• Symptoms include lesions on limbs.</li> <li>• Preventive measure is vaccination.</li> </ul>
<p><b>Foot and Mouth Disease FMD</b> affects cattle and sheep.</p> <p>It can affect humans in extremely rare cases.</p>	Picornavirus.	<ul style="list-style-type: none"> <li>• Symptoms include sores and blisters, fever, weakness and decrease in milk production.</li> <li>• Vaccines are available but are not highly effective.</li> <li>• FMD is associated with ethical issues as sometimes animals are unnecessarily slaughtered.</li> </ul>
<b>Protozoa borne diseases</b>		
<p><b>Trypanosomiasis</b> can affect a wide range of vertebrates.</p> <p>Infection by <i>Trypanosoma evansi</i> is extremely rare in humans.</p>	<i>Trypanosoma evansi</i>	<ul style="list-style-type: none"> <li>• Symptoms include fever, anemia, lethargy and weight loss.</li> <li>• Treatment can be carried out by chemotherapy.</li> </ul>
<p><b>Theileriosis</b> affects cattle.</p> <p>It does not affect humans.</p>	<i>Theileria annulata</i> .	<ul style="list-style-type: none"> <li>• Symptoms include fever anemia, jaundice and enlarged lymph nodes.</li> <li>• Tick control is an important preventive measure.</li> <li>• Tetracycline is effective in treatment.</li> <li>• Vaccine is available.</li> </ul>

Helminth borne diseases		
<p><b>Ascariasis</b> affects cattle.</p> <p>No recorded cases of affecting humans.</p>	<i>Neoscaris vitulorum</i>	<ul style="list-style-type: none"> <li>• Symptoms may not be clear. Liver damage, intestinal blockage is observed.</li> <li>• Vaccine is not available.</li> </ul>
Fungal diseases		
<p><b>Aflatoxicosis</b> affects poultry and dogs.</p> <p>The toxin can cause illness in humans also.</p>	<i>Aspergillus flavus</i>	<ul style="list-style-type: none"> <li>• It can cause liver damage.</li> <li>• Antidotes as such remain unavailable.</li> </ul>

## 6.2 Causes and Preventive Measures

- Causes of diseases can be mutant genes (genetic diseases), improper nutrition and pathogens.
- Breeding aims to eliminate genetic diseases.
- Nutrition is a factor that can be controlled by the humans operating the animal husbandry or similar activity with relative ease.
- However, it is important to control the spread of disease due to pathogens. Not only do these diseases affect the productivity, some of them also pose a risk to human health.
- Some measures to check the spread of diseases include- vaccination, isolation of infected or even suspected to be infected cases, cleanliness and disinfection etc.
- It is important to notify government bodies about the instance of any outbreak as they may initiate measures to counter the same.



### TRY IT YOURSELF

1. Name a few animal diseases and their causative organisms.
2. List down some preventive/control measures of animal diseases.

## 7. Plant Breeding

- It should be understood that along with better management, it is highly essential to use improved varieties of plants if the output is to be drastically improved.
- Purposeful manipulation of plant species in order to create desired plant varieties that have a better yield, high tolerance to stress related factors and enhanced disease resistance is called plant breeding.

- Desirable characters as such include better quantity and quality of yield, tolerance to draught, salinity, high/low temperatures, disease resistance, pest resistance etc.
- Generally pure lines with desirable characters are crossed.
- Artificial selection is employed to obtain the desired variety.
- Genetic tools are also being employed to achieve the same.

## 7.1 Steps Involved in Plant Breeding

- **Variability and Parent Selection**

Variability is the basic necessity as unless there is no variability, there can be no 'desirable characters' which can be used to create an enhanced variety. The entire collection of plants and/or seeds having all the diverse alleles for all genes in a given plant is called germplasm collection.

Plants possessing one or more of the desired characters are selected as parents.

- **Pureline Generation**

Purelines homozygous for one or more of the desired characters are generated whenever possible. Understandably, the use of purelines highly increases the probability of incorporation of the desired characters in the progeny.

- **Crossing**

The parental plants are crossed. As crop plants possess several genes it should be noted that the frequency of occurrence of progeny possessing a combination of the desired genes from both the parents will be very low.

- **Selection and Generation of Purelines**

The progeny has to be tested for the possession of the required genes/traits. The desired progeny then has to be self pollinated to generate pure lines so that the traits are homozygous (not eliminated in the subsequent generations).

- **Testing and Launch in the Market**

The new plant variety is generally grown in test farms to analyse its performance outside the experimental set up in comparison to cultivars already in use. Following positive results, it is marketed. Otherwise it may have to undergo improvement. The cultivar is also tested in actual farms located in different regions of the country.

## 7.2 The Green Revolution

- It was the research, development and actual implementation of reforms in agriculture that lead to a significant increase in yield.

- In India implementation began in the 60s. Semi-dwarf varieties of rice and wheat were grown. The yield increased tremendously.
- Sonalika and Kalyan Sona were high yielding and disease resistant varieties of wheat which were introduced all over the wheat-growing belt of India.
- Rice varieties derived from IR-8 (Developed at International Rice Research Institute, Phillipines) and Taichung Native-1 (Taiwan) were used. Later better-yielding semi dwarf varieties Jaya and Ratna were developed in India.
- *Saccharum barberi* variety of sugarcane was traditionally grown in North India. It had poor sugar content and yield. *Saccharum officinarum* which was being grown in South India had thicker stems and higher sugar content but did not grow well in North India. These two species were successfully crossed to get varieties with desired characters that could grow well in North India too.
- Hybrid varieties of maize, jowar and bajra having high draught resistance and producing more grains were developed.

### 7.3 Plant Breeding for Disease Resistance

- Resistance of the host plant is the ability to prevent the pathogen from causing disease.
- Losses due to plant diseases can be extremely high.
- Lack of resistance can necessitate high use of pesticides or other chemicals which again can have a lot of side effects (from reduction in yield to bio-magnification).
- Steps for generating this type of cultivars is similar to the steps of conventional breeding. (Selection of parents, preparation of pure lines, their crossing, selection and development).
- Examples- Himgiri wheat is resistant to hill bunt and leaf and stripe rust disease, Pusa Shubhra is resistant to black rot and curl.
- Resistance to yellow mosaic virus in bhindi (*Abelmoschus esculentus*) was transferred from a wild species.
- Sometimes a limitation is encountered due to lack of availability of a variety which possesses the desired resistance. Sometimes it is possible to obtain these characters by inducing random or targeted mutations in the plant's genome.
- Genetic engineering and variations arising in plants generated from tissue culture (somaclonal variations) are also alternative approaches of obtaining resistant varieties.
- Example- In mung bean, resistance to yellow mosaic virus and powdery mildew were induced by mutations.

## 7.4 Plant Breeding for Insect Resistance

- Steps for generating this type of cultivars is similar to the steps of conventional breeding. (Selection of parents, preparation of pure lines, their crossing, selection and development.
- Examples- Pusa Gaurav variety of Rapeseed mustard is resistant to aphid infestation, Pusa Sawant variety of Bhindi is resistant to infestation by fruit borer.

## 8. Biofortification

- Breeding crops with higher nutritional value is called biofortification.
- The new cultivar may have higher levels of vitamins and minerals, higher protein levels, healthier fat profile etc.
- It can lead to improvement in public health
- In the year 2000, maize hybrids that had twice the amount of the amino acids, lysine and tryptophan, compared to existing cultivars were developed.
- Atlas 66 a wheat variety having a high protein content can be used as a parental generation in developing biofortified wheat.
- A rice variety with 5 times more iron than normal cultivars has been developed.

## 9. Single Cell Protein (SCP)

- The present quantity of agricultural production is not enough to cater to the increasing needs.
- More than 25% of human population is suffering from hunger and malnutrition.
- It takes 3-10 kg of grain to produce 1 kg of meat by animal farming.
- Thus it is essential to also explore alternative sources of food (other than plants and meat). One of them is single cell protein or SCP.
- Bacteria like spirulina can be grown on wastes from some industries. They can be consumed as food containing proteins, carbohydrates, fats etc.
- The advantage of this approach is the high biomass production by the bacteria.
- An equivalent mass of spirulina can produce several times more proteins than a mammal like cow.
- Many people are unwilling to consume SCP as food but it can be used as animal feed with relative ease.

## 10. Tissue Culture

- The growth of plant or animal tissues in culture medium is called tissue culture.
- Plant tissue culture is extensively used in research aimed at enhancing food production.

- Plants possess an ability to regenerate a whole plant from a single cell or explant. This ability is called totipotency.
- The explant (any part of the plant) is kept in a nutrient medium in sterile conditions. The medium should have a carbon source, some specific salts, vitamins, some amino acids, auxins and similar growth regulatory substances.
- Large number of plants can be generated in a very short period of time using plant tissue culture. This is called micro-propagation.
- Each of the plants are clones of the original plant.
- Bananas, apples etc. have been produced on a commercial scale by using plant tissue culture.
- A plant obtained from meristem culture is free from virus or any other infection.
- Cell wall of plants can be digested to form protoplast surrounded by plasma membrane. These protoplasts can be fused to produce somatic hybrids.
- Somatic hybridisation can be used to obtain hybrids that are not possible by sexual reproduction. (E.g. tomato-potato hybrid, rice-carrot hybrid etc.)
- Anther culture can be used to obtain haploid plants. These plants can be used for crossing or in research.
- Embryo culture can be used to grow embryos that may not survive ordinarily.

## 11. Plant Disease and their Control

### Plant disease caused by fungi

- Fungi are parasitic organisms. They grow on various plant parts and damage the plant.
- Infection can generally be seen as spots, patches and wilting.
- Use of chemicals, use of resistant varieties and minimizing the contact between affected and non-affected plants are the means of control.
- Examples - Alternaria blight affecting fruit, vegetable and other plants  
Nectria canker affecting bark of hardwood trees.

### Plant disease caused by bacteria

- The symptoms may not be visible. If visible they are somewhat similar to fungal symptoms. Slimy secretions may be seen.
- The prevention and control measures are similar to those which apply to fungal diseases.
- Examples - Fire blight affecting apples, pears and some other fruit trees.  
Stewart's wilt affecting sweet corn.

### Plant disease caused by viruses

- The symptoms may not be visible and if they are they might be similar to those of fungal or bacterial diseases.
- The prevention and control measures are similar to those which apply to fungal diseases.
- Tobacco Mosaic Virus infecting tobacco plants and Cauliflower Mosaic Virus infecting cauliflower plants

In general there are no specific cures for plant diseases. Prevention and control of spread are the best defences.



#### TRY IT YOURSELF

1. Rinderpest is The disease al
 

(1) Buffaloes	(2) Cattle	(3) Pigs	(4) Horses
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2. Fool and mouth disease Macke
 

(1) Cattle	(2) Camels	(3) Sheep and goats	(4) Horses
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#### KNOWLEDGE BUILDER

- Agriculture employs nearly 62% of the Indian population.
- Agriculture account for 33% of India's GDP.
- High aspartic acid, low nitrogen and sugar content in maize increases the resistance to stem borers in maize.
- Farming practice that help protect the environment by conserving water and energy and by limiting the use of synthetic pesticides and fertilizers are termed as sustainable agriculture.
- Wheat production increased from 11 million tonne to 75 million tonnes while rice production went up from 35 million tonnes to 89.5 million tonnes during the period 1960 to 2000.
- Sonalika and Kalyan sona are disease resistant high yielding varieties of wheat released in 1963.
- Hairy leaves in plants may be associated with resistance to insect pests E.g. resistance to jassids in cotton and cereal leaf beetle in wheat.
- Solid stems lead to non-preference by the stem sawfly in wheat.
- Smooth leaved and nectar-less cotton varieties do not attract bollworms in cotton.
- Atlas 66 variety of wheat has been used as donor for improving cultivated wheat as it has high protein content.
- Baculoviruses affect some insects and other arthropods. They can be used as biological pesticidal agents.

## Summary

- It is important to note that the existing yield from agriculture and animal husbandry is not sufficient enough to cater to the needs of the growing population. Improved methods should be used to enhance this yield.
- Breeding enables us to create animals or plants with a desired combination of beneficial traits from different species. This is an important means of increasing the yield.
- The animals/plants obtained from breeding commonly are able to produce better quality and quantity of produce, have disease resistance and also may be able to thrive in stress conditions like temperature extremes or high salinity.
- Animal breeding can be natural or artificial (where actual mating does not take place). Mutation can be used to obtain certain desirable characters in plants.
- Other measures to improve yield from animals include proper nutrition, cleanliness, vaccination, medical care etc.
- Animal husbandry is the rearing of animals for obtaining food and commercial benefits.
- Cattle, sheep, goats, pigs, camels, yaks etc are some animals that are reared from the point of view of food production.
- Poultry farming is the rearing of birds from the point of view of food production.
- Hens, ducks etc are the important birds reared by humans.
- Apiculture is the rearing of bees.
- Honey, beegum, beeswax etc. are obtained from bees.
- *Apis mellifera* and *Apis indica* are commercially important species of bees.
- Fishes are reared in fisheries.
- In India, Catla, Rohu and Mrigala are the important carps that are reared.
- Use of modern techniques can enhance yield from apiculture and fisheries.
- Single cell protein or SCP is an alternative food source apart from plants and meat. It is bacteria like spirulina grown on wastes from some industries.
- The main advantage of SCP is the high biomass generation efficiency of bacteria as compared to plants and animals.
- Tissue culture is a technique of growing cells in artificial medium.
- Plant tissue culture can be used to produce hybrids and also to produce large quantity of clones via micro-propagation.
- In comparison to human diseases, prevention is highly important (in comparison with treatment) in plant and animal diseases.
- It is important to use disease resistant varieties and minimize the contact between affected and non-affected organisms.
- It is also important to report instances of animal and plant diseases to government bodies as they can take appropriate measures to check the spread of the disease.

**EXERCISE****Objective Exercises**

**Q.1** Honey bee after discovering the new source of nectar/honey can convey this information but

- (A) Cannot convey the direction
- (B) Can convey the direction by round or tail waving dance
- (C) Can convey the direction by round dance only
- (D) Can convey the direction by tail waving dance only

**Q.2** Maximum fat contents are present in the meat of

- (A) Pork
- (B) Mutton
- (C) Beef
- (D) Chicken

**Q.3** If a honey bee is conveying an information, by round dance then the distance of source will be about

- (A) 1000 metres
- (B) 50 metres
- (C) 2000 metres
- (D) 150 metre

**Q.4** Domestication of honey bee is called

- (A) Sericulture
- (B) Apiculture
- (C) Tissue culture
- (D) Pisciculture

**Q.5** If the source is opposite to the direction of sun and distance is more than 75 metres then honey bee will convey the direction by

- (A) Clockwise round dance
- (B) Upright down tail waving dance
- (C) Anticlockwise round dance
- (D) Opposite to 2

**Q.6** Domestication of silk worm is called

- (A) Sericulture
- (B) Pisciculture
- (C) Apiculture
- (D) Horticulture

**Q.7** Which set is of beneficial insects, to man

- (A) Honey bee, Lac insect, cochineal insect
- (B) Silk worm, honey bee, wasp
- (C) Honey bee, silk worm, and cockroach
- (D) None of the above

**Q.8** Silk is produced by

- (A) Larva                      (B) Cocoon                      (C) Larva and adult moth                      (D) Adult moth

**Q.9** Largest silk producing state of India is

- (A) Karnataka                      (B) Bihar                      (C) Bengal                      (D) Assam

**Q.10** The insect thrives on *Morus alba* is

- (A) Lac insect                      (B) Cochineal insect  
(C) Honey bee                      (D) Silk moth

**Q.11** Queen bee is specified for

- (A) Administration                      (B) Making hive  
(C) Egg laying                      (D) Collection of food

**Q.12** Silk industry is related to

- (A) Sericulture                      (B) Apiculture                      (C) Pisciculture                      (D) Horticulture

**Q.13** A queen honey bee lays eggs of

- (A) One type from which all castes develop  
(B) Two types, one forming queen and workers and second forming drones  
(C) Three types forming queen, drone and workers  
(D) Unfertilized eggs die while fertilised ones form all castes

**Q.14** Lac is a product of

- (A) Faecal matter                      (B) Secretion from body  
(C) Excretion from body                      (D) Excess food oozing out of the body

**Q.15** Silk is produced by

- (A) Larva                      (B) Adult moth  
(C) Both (A) and (B)                      (D) Cocoon/Pupa

**Q.16** Which among the following is real product of honey bee

- (A) Honey                      (B) Pollen                      (C) Bee wax                      (D) Propolis

**Q.17** Super ovulation and embryo transplantation are meant for improving

- (A) Human race      (B) Livestock      (C) Poultry      (D) Plants

**Q.18** Worker Bees are

- (A) Fertile males      (B) Fertile females  
(C) Sterile females      (D) Sterile males

**Q.19** Honey is collected by

- (A) Wasp      (B) Housefly      (C) Butterfly      (D) Bee

**Q.20** Ranikhet disease is connected with

- (A) Honey bee      (B) Hens      (C) Fishes      (D) Pigs

**Q.21** Induced breeding (Hyphophysation) is carried out in case of

- (A) Pisciculture      (B) Apiculture      (C) Sericulture      (D) Lac culture

**Q.22** Rearing of bees is

- (A) Horticulture      (B) Apiary      (C) Apiculture      (D) Poultry

**Q.23** Which of the following represents honey bee?

- (A) *Apis dorsata*      (B) *Periplanata americana*  
(C) *Mangifera indica*      (D) All of the above

**Q.24** Lac is produced by

- (A) Males  
(B) Females  
(C) Far more by females than males  
(D) More by males than females

**Q.25** Silkworm larva spins silk from

- (A) Inside to outside      (B) Outside to inside  
(C) Random fashion      (D) Anterior to posterior side

**Q.26** Three carp fishes, Catla, Labeo and Cirrhina, can be grown together in the same pond more economically as they have

- (A) Positive interactions (B) Commensalism  
(C) Symbiosis (D) No competition for food

**Q.27** Fish introduced in India by foreigners is

- (A) *Labeo rohita* (B) *Mystus singhala*  
(C) Pomphret (D) *Clarrus batrachus*

**Q.28** Best aquarium is located at

- (A) Vishakhapatnam (B) Chennai  
(C) Tarapur, Mumbai (D) Z.S.I Calcutta

**Q.29** To increase milk yield, cow is given

- (A) Sorbitol (B) Stibesterol (C) Prolactin (D) Gonadotropin

**Q.30** In Silkworm, if juvenile hormone is absent at the time of larval moulting, the worm will

- (A) Die (B) Moults into larval stage  
(C) Moults into pupa (D) Moults into adult

**Q.31** Nagpuri buffalo is

- (A) Milker (B) Draught cattle (C) Dual purpose (D) Grazer

**Q.32** Which amongst the following is used in raising super-milk cows

- (A) Artificial insemination with pedigree bull (B) Embryo transplantation  
(C) Superovulation of high yielding cow (D) All of the above

**Q.33** Inland fisheries are

- (A) Deep sea fishing  
(B) Capturing fishes from sea coast  
(C) Raising and capturing fishes in fresh water  
(D) Oil extraction from fish

**Q.34** Silkworm is

- (A) Beetle                      (B) Worm                      (C) Fly                      (D) Moth

**Q.35** Which of the following is not a plant product

- (A) Hemp                      (B) Silk                      (C) Cotton                      (D) Flax

**Q.36** Pisciculture is rearing and production of

- (A) Fishes                      (B) Birds                      (C) Reptiles                      (D) Wool yielding animals

**Q.37** Hormone used for inducing lactation in sterile cows is

- (A) Estrogen                      (B) Progesterone                      (C) Relaxin                      (D) Stilbestrol

**Q.38** Jaffarbadi, Murrah and Meshasna are breeds of

- (A) Cow                      (B) Buffalo                      (C) Goat                      (D) Sheep

**Q.39** Maximum silk is produced in

- (A) Assam                      (B) Karnataka                      (C) Gujrat                      (D) Kerala

**Q.40** Tassar silk is obtained from

- (A) *Antheraea roylei*                      (B) *Bombyx mori*  
(C) *Apis indica*                      (D) *Apis dorsata*

**Q.41** Fishes reared in culture fishery in India are

- (A) Salmon and Rohu                      (B) Salmon and *Catla*  
(C) *Catla* and Magur                      (D) Rohu and *Catla*

**Q.42** Exotic breeds of poultry are

- (A) White leghorn and Rhode Island Red  
(B) Rhode island red and Aseel  
(C) Plymouth and Aseel  
(D) White leghorn and aseel



**Q.52** The respiratory organ of silkworm is

- (A) Lungs                      (B) Tracheae                      (C) Malpighian tubules                      (D) Skin

**Q.53** The gestation period of elephant is about

- (A) 11 month                      (B) 15 month                      (C) 22 months                      (D) 32 months

**Q.54** Oak silkworm is

- (A) *Antherea roylei*                      (B) *Apis florea*  
(C) *Bombyx mori*                      (D) *Clarias batrachus*

**Q.55** Which of the following species of silkworm are found in India?

- (A) *Bombyx mori*                      (B) *Anthera paphia*  
(C) *Kerria*                      (D) All of these

**Q.56** Which of the following is a fresh water fish?

- (A) Pomphret                      (B) Rohu                      (C) Sardine                      (D) Salmon

**Q.57** Eri silk moth feeds on

- (A) Mulberry leaves                      (B) Arundi leaves  
(C) Ficus leaves                      (D) Neem leaves

**Q.58** Wax is obtained from

- (A) Apiculture                      (B) Aquaculture                      (C) Lac culture                      (D) Sericulture

**Q.59** Pebrine disease is found in

- (A) Fish food                      (B) Honeybees                      (C) Silk moth                      (D) Hens

**Q.60** Queen Bee is adapted for

- (A) Laying eggs  
(B) Laying eggs and rearing the young  
(C) Preparing honey  
(D) Controlling other bees

**Q.61** Silk is produced by

- (A) Cuticle of larva (B) Salivary glands of larva  
(C) Cocoon (D) Salivary gland of adult

**Q.62** Lac is obtained from

- (A) *Laccifer* (B) *Bombyx* (C) *Dactylopius* (D) *Lytta*

**Q.63** Commercial silk is obtained from

- (A) Cocoon (B) Caterpillar  
(C) Adult moth (D) Both egg and adult moth

**Q.64** A new breed of sheep developed in India by cross breeding, called 'Hisardale' It is a cross of

- (A) Bikaneri ewes and Marino rams  
(B) Marino ewes and Bikaneri rams  
(C) Malavari ewes and Bikaneri rams  
(D) Bikaneri ewes and Malavari rams

**Q.65** Primary and secondary product of apiculture are

- (A) Wax is primary product but honey is secondary product  
(B) Honey is primary product but wax is secondary product  
(C) Both wax and honey are considered as secondary product as some nutritive substances are also obtained from honey bee which are primary product  
(D) No criteria is set to differentiate primary and secondary product in apiculture

**Q.66** In MOET the animal is either mated with an elite bull or artificially inseminated. The fertilized eggs are collected to transfer to surrogate mothers. Which among these statements is correct

- (A) Fertilized egg is collected at 8-32 cells stage and no need of surgery  
(B) Fertilized egg is collected at 8-32 cells stage and surgery is done for it  
(C) Fertilized egg is collected at only 4 cells stage and it is done by surgery  
(D) Fertilized egg is collected at 64 cells stage and surgery is done for it

**Q.67** Hybrid breed of sheep is

- (A) Sunanhdini (B) Holstein (C) Brown swiss (D) Hisardale

**Q.68** Surrogate mother is used for

- (A) Artificial insemination
- (B) Future mother with transplanted embryo
- (C) Induction of lactation
- (D) All of the above

**Q.69** MOET is method of

- (A) Fish cultivation
- (B) Cloning of sheep
- (C) Hybridization in cattle
- (D) Bee-keeping

**Q.70** which of the following is/are marine water fishes?

- (A) Mackerel
- (B) Pomfrets
- (C) Sardines
- (D) All of the above

**Q.71** Which among the following is real product of honey bee?

- (A) Honey
- (B) Propolis
- (C) Beeswax
- (D) Pollen

**Q.72** A milch breed of cow is

- (A) Haryana
- (B) Malvi
- (C) Kank raj
- (D) Sahiwal

**Q.73** Pisciculture is rearing and production of

- (A) Sheep
- (B) Birds
- (C) Fishes
- (D) Honey bee

**Q.74** Which of the following is a fresh water fish?

- (A) Catla
- (B) Mackerel
- (C) Pomfrets
- (D) Hilsa

**Q.75** Queen Bees are

- (A) Sterile females
- (B) Fertile males
- (C) Fertile females
- (D) Sterile males

**Q.76** What is the root of any breeding programme?

- (A) Mutation
- (B) Green revolution
- (C) Genetic variability
- (D) Genetic similarity

**Q.77** Which tropical canes grown in south India had thicker stems and high sugar content but did not grow well in north India?

- (A) *Saccharum barberi* (B) *Saccharum spontaneum*  
(C) *Saccharum robustum* (D) *Saccharum officinarum*

**Q.78** "Pusa Komal" variety of cow pea, which developed by hybridisation and selection is mainly resistance for

- (A) Powdery mildew (B) Yellow mosaic virus  
(C) Bacterial blight (D) White rust

**Q.79** Drought breeds produce

- (A) Good milk producing Cows (B) Good working bullocks  
(C) Both (A) and (B) (D) None of the above

**Q.80** In which crop resistance to yellow mosaic virus were induced by mutation?

- (A) Mung bean (B) Cow pea (C) Wheat (D) Brassica

**Q.81** Smooth leaved and nectar less cotton varieties do not attract which one of following pests?

- (A) Aphids (B) Jassids (C) Boll worms (D) Shoot borer

**Q.82** The main steps of plant breeding programmes is given below

- (1) Cross hybridisation among the selected parents
- (2) Testing release and commercialisation of new cultivars
- (3) Collection of variability
- (4) Selection and testing of superior recombinants
- (5) Evaluation and selection of parents

Arrange above steps in a systematic way

- (A) 5 3 1 2 4 (B) 3 5 1 2 4 (C) 3 5 1 4 2 (D) 5 3 1 4 2

**Q.83** 250 kg cow produces how much amount of protein in a days?

- (A) 200 gm (B) 20 gm (C) 2 gm (D) 2000 gm

**Q.84** In fungi plant symbiotic association, the fungus symbiont absorb which nutrient from soil and passes it to the plants

- (A) Nitrogen                      (B) Phosphorus                      (C) Manganese                      (D) Calcium

**Q.85** Nobel laureate Norman E. Borlaug developed semi dwarf variety of

- (A) Wheat                      (B) Sugarcane                      (C) Mustered                      (D) Chilli

**Q.86** Which one of the following is an example of somatic hybridisation?

- (A) Bt cotton                      (B) Pomato                      (C) Golden rice                      (D) All of these

**Q.87** IARI, New Delhi has released several vegetables crops that are rich in

- (A) Vitamin                      (B) Hormone                      (C) Minerals                      (D) Both (A) and (C)

**Q.88** Which plant breeding step is very tedious and time consuming?

- (A) Selection and testing of superior recombinants  
(B) Cross hybridisation among the selected parents  
(C) Collection of variability  
(D) Evaluation and selection of parents

**Q.89** Which vegetable crop rich in vitamin C has released by IARI New delhi?

- (A) Spinach                      (B) Lablab                      (C) Mustared                      (D) Bathua

**Q.90** Ladybird is useful to get rid of

- (A) Aphids                      (B) Mosquitoes                      (C) Boll worm                      (D) Jessids

**Q.91** You are a plant breeder. Which trait or character that you have firstly tried to incorporate into crop plants?

- (A) Increase crop yield and improved quality  
(B) Increase tolerance to environmental stresses  
(C) Increase resistance to pathogens  
(D) Increase tolerance to insect pests

**Q.92** Match the following

Column I	Column II
(a) Brown rust of wheat	(i) Virus
(b) Tobacco mosaic	(ii) Bacteria
(c) Black rot of crucifers	(iii) Fungi
(d) Red rot of sugarcane	(iv) Boll worm

(A) a – (ii), b – (i), c – (iii), d – (iv)

(B) a – (iv), b – (iii), c – (ii), d – (i)

(C) a – (iii), b – (ii), c – (i), d – (iv)

(D) a – (iii), b – (i), c – (ii), d – (iii)

**Q.93** How much percent of the population of India get employed by agriculture?

(A) 82

(B) 62

(C) 17

(D) 92

## Previous Years' Questions

**Q.1** Earliest animal to be domesticated by primitive man was :

(CBSE 1996)

(A) Goat

(B) Dog

(C) Horse

(D) Cat

**Q.2** Most commonly maintained species of bees by bee-keepers is :

(AMU 2010)

(A) *Apis mellifera*

(B) *Apis dorsata*

(C) *Apis indica*

(D) *Apis florea*

**Q.3** Identify the edible fresh-water teleosts?

(KCET 2001)

(A) Sharks

(B) Catla catla

(C) Rays and skates

(D) Hilsa hilsa

**Q.4** Which one is a viral disease in silkworm?

(KCET 2001)

(A) Flacherie

(B) Pebrine disease

(C) Muscardine

(D) Maggot disease

**Q.5** MOET is method of :

(KCET 2001)

(A) Fish cultivation

(B) Cloning in sheep

(C) Hybridisation in cattle

(D) Birth control in humans

**Q.6** Which of the following combinations is generally recommended for composite fish farming in India ?  
(MP-PMT 2000)

- (A) *Catla*, *Labeo* and *Cirrhinus* (B) *Catla*, *Cyprinus* and *Clarius*  
(C) *Clarius*, *Channa* and *Cyprinus* (D) *Cirrhinus*, *Cyprinus* and *Channa*

**Q.7** Multiple ovulation and embryo transfer is the method of : (Kerala PMT 2002)

- (A) Fish cultivation (B) Prawn cultivation  
(C) Cloning monkeys (D) Hybridisation in cattle

**Q.8** Which one of the following food fishes of U.P. is a carp, which is cultivated in U.P. but is not a native of India ? (PCS 2002)

- (A) *Labeo rohita* (B) *Clarius betrachus*  
(C) *Channa pinctatus* (D) *Hypophthalmichthys molitrix*

**Q.9** Among the Indian major carps, the fastest rate of growth is observed in : (PCS 2005)

- (A) *Labeo bata* (B) *Catla catla* (C) *Labeo rohita* (D) *Labeo calbasu*

**Q.10** The drug used for deworming the poultry birds is : (EAMCET 2002)

- (A) Antihistamine (B) Antiviral (C) Anthelmintic (D) Antibiotic

**Q.11** Bombay duck is : (EAMCET 2002)

- (A) Hilsa hilsa (B) Harpadon neherius  
(C) *Pediceps ruficolis* (D) *Corrochromis mossambicus*

**Q.12** In Which country, the 'DOGS' were worshipped as "GODS" ? (AIIMS 2003)

- (A) Italy (B) Egypt (C) Greece (D) Mongolia

**Q.13** The Mediterranean type of popular fowls are called : (EAMCET 2003)

- (A) White Leghorn (B) New Hampshire  
(C) Plymouth rock (D) Rhodesian red

**Q.14** The production of new characteristics by introducing new genes and altering the genome is called : **(TN-PMT 2003)**

- (A) Splicing                      (B) Genetics                      (C) Gene manipulation                      (D) Totipotency

**Q.15** Plants raised through tissue culture techniques are : **(TN-PMT 2003)**

- (i) Genetically uniform                      (ii) Used as inoculum  
(ii) Genetically similar                      (iv) Called clones :  
(A) (i), (ii) and (iii) are correct                      (B) (i) and (iv) are correct  
(C) (ii) and (iii) are correct                      (D) (iii) and (iv) are correct

**Q.16** Cultivation of Bt cotton has been much in the news. The prefix "Bt" means: **(AIIMS 2004)**

- (A) 'Barium-treated' cotton seeds  
(B) 'Bigger thread' variety of cotton with better tensile strength  
(C) Produced by 'Biotechnology' using restriction enzymes.  
(D) Carrying an endotoxin gene from *Bacillus thuringiensis*

**Q.17** India's wheat yield revolution in the 1960s was possible primarily due to: **(CBSE 2004)**

- (A) Mutations resulting in plant height reduction  
(B) Quantitative trait mutations  
(C) Hybrid seeds  
(D) Increased chlorophyll content

**Q.18** The technique of obtaining large number of plantlets by tissue culture method is called: **(CBSE 2004)**

- (A) Micropropagation                      (B) Macropropagation  
(C) Plantlet culture                      (D) Organ culture

**Q.19** Mule is a product of : **(AFMC 2004)**

- (A) Inbreeding                      (B) Mutation  
(C) Recombination                      (D) Interspecific hybridization

**Q.20** One of the following is a disease of poultry : **(KCET 2004)**

- (A) Anthrax                      (B) Pebrine disease  
(C) Ranikhet disease                      (D) Foot and mouth disease

**Q.21** Choose the cat fish from the following : **(KCET 2004)**

- (A) *Catla catla*                      (B) *Wallaga attu*                      (C) *Labeo rohita*                      (D) *Cirrhinus mrigla*

**Q.22** Scientific name zebu of is : **(KCET 2004)**

- (A) *Bos indicus*                      (B) *Bombyx mori*                      (C) *Bubalus bubalus*                      (D) *Gallus gallus*

**Q.23** Dual breed variety of cattle is : **(Manipal 2004)**

- (A) Jersey                      (B) Aryshire                      (C) Brown swiss                      (D) All of these

**Q.24** Cryopreservation is done at temperature : **(BV – Pune 2004)**

- (A) – 140°C                      (B) – 120°C                      (C) – 196°C                      (D) – 273°C

**Q.25** Which pair is essential for the growth of fish in water? **(AIIMS 2006)**

- (A) Nitrates and sulphates  
(B) Sulphanates and carbonates  
(C) Calcium and phosphorus  
(D) Carbonates and phosphates

**Q.26** The name of Norman Borlaug is associated with : **(CBSE 2005)**

- (A) Green revolution                      (B) Yellow revolution  
(C) White revolution                      (D) Blue revolution

**Q.27** In callus culture, roots can be induced by supply of : **(BHU 2005)**

- (A) Auxin                      (B) Cytokinin                      (C) Gibberellin                      (D) Ethylene

**Q.28** Which of the following is man made? **(BHU 2005)**

- (A) Secale                      (B) Triticale                      (C) Triticum                      (D) *Cicer arietinum*

**Q.29** Somaclonal variation is seen in : **(AIIMS 2006)**

- (A) Tissue culture grown plants                      (B) Apomicts  
(C) Polyploids                      (D) Vegetatively propagated plants

## ANSWER KEY

### Objective Questions

Q.1 D	Q.2 C	Q.3 B	Q.4 B	Q.5 A	Q.6 A
Q.7 A	Q.8 A	Q.9 A	Q.10 D	Q.11 C	Q.12 A
Q.13 B	Q.14 B	Q.15 A	Q.16 C	Q.17 B	Q.18 C
Q.19 D	Q.20 B	Q.21 A	Q.22 C	Q.23 B	Q.24 C
Q.25 B	Q.26 D	Q.27 C	Q.28 C	Q.29 B	Q.30 D
Q.35 A	Q.32 D	Q.33 C	Q.34 D	Q.35 B	Q.36 A
Q.37 D	Q.42 B	Q.39 B	Q.40 A	Q.41 D	Q.42 A
Q.43 C	Q.44 D	Q.49 B	Q.46 A	Q.47 B	Q.48 C
Q.49 C	Q.50 D	Q.51 B	Q.56 B	Q.53 C	Q.54 A
Q.55 A	Q.56 B	Q.57 B	Q.68 A	Q.63 C	Q.60 A
Q.61 B	Q.62 A	Q.63 A	Q.64 A	Q.65 A	Q.66 A
Q.67 D	Q.68 B	Q.69 C	Q.70 D	Q.71 C	Q.72 C
Q.73 C	Q.74 A	Q.75 C	Q.76 C	Q.77 D	Q.78 C
Q.79 D	Q.80 A	Q.81 C	Q.82 C	Q.83 A	Q.84 B
Q.85 A	Q.86 B	Q.87 B	Q.88 B	Q.89 C	Q.90 A
Q.91 A	Q.92 D	Q.93 B			

### Previous Years' Questions

Q.1 B	Q.2 A	Q.3 B	Q.4 B	Q.5 C	Q.6 A
Q.7 D	Q.8 D	Q.9 C	Q.10 C	Q.11 B	Q.12 B
Q.13 A	Q.14 C	Q.15 B	Q.16 D	Q.17 C	Q.18 A
Q.19 D	Q.20 C	Q.21 B	Q.22 A	Q.23 B	Q.24 C
Q.25 C	Q.26 A	Q.27 A	Q.28 B	Q.29 A	