**Chapter 2. Domestication, Plant Introduction and Acclimatisation**

**Dr. Rani A. Jadhav1, Dr. A. V. Shinde2**

1. Junior Research Fellow,

AICRP on Linseed and Mustard,

College of Agriculture, Nagpur - 440001

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (India)

Email ID- [ranijadhav74@gmail.com](mailto:ranijadhav74@gmail.com)

1. Assistant Professor

Department of Genetics and Plant Breeding,

Nanasaheb Kadam College of Agriculture, Gandheli, Aurangabad – 31001

Email ID- [akshatashinde13@gmail.com](mailto:akshatashinde13@gmail.com)

**ABSTRACT**

Domestication is the process whereby a population of animals and plants become accustomed to human provision and control. Domestication is usually said to be the end-point of a continuum which starts with exploitation of wild plant. From the wild weedy species, the existing plants which are cultivated have been derived. In plant introduction, the group of genotype of plants or a single genotype is to be taken into new atmospheres where they have not grown previously. When a plant or animal adjusts in a variable environment like, change in altitude, humidity, temperature, pH or photoperiod is known as acclimatization. This chapter gives the total information of domestication, plant introduction and acclimatization.

**Keywords:** Domestication, Introduction, Wild Genotypes, Acclimatization

1. **DOMESTICATION**

Plant domestication is the evolutionary process whereby a plants population becomes adapted to human provision and control (Pourkheirandish and Komatsuda, 2007). At the dawn of agriculture, approximately 10,000 years ago crop plant domestication began (Harlan, 1992). According to many authors domestication is usually said to be the end-point of a continuum which starts with wild plants exploitation, it will continues through cultivation of such plants which are selected from the wild but still they are not genetically different from wild plants (Harlan 1992, Zohary and Hopf, 1993). For cultivation of plants from the wild, on the farm or home gardens or fields is a common practice as said by local communities. Under diverse agro ecosystems, this practice is being carried out. Many landraces, varieties and cultivars of plants have been developed through the process of domestication to fulfil human or animal basic need of food, fibre, medicine, building materials, etc. (Sweeney and Mc Couch, 2007).

‘The process whereby a population of animals and plants become accustomed to human provision and control is called domestication’. The process of bringing wild plants under cultivation by humans is called plant domestication. Domesticated plants are grown on farms and become dependent upon humans for propagation. Domestication changes the physical characteristics of the plants under domestication. It is the process of hereditary reorganization of wild plants into domestic and cultivated forms according to the interests of people. In its strictest sense it refers to the initial stage of human mastery of wild animals and plants. The word domestication is used as a synonym of taming, though this word can apply to a single animal, while domestication concerns a population or a species as a whole.

Different factors which include various agricultural practices, change in agricultural environments and artificial selection by humans which drives the process of crop domestication. Moreover population sizes of crops reduced due to agricultural a practice which permits the genetic drift which is responsible to change the frequencies of genotypes in addition to loss of alleles randomly (Gross and Olsen, 2010; Olsen and Wendel, 2013; Cowling *et al*, 2013). As per Varshney *et al* (2017), during and after domestication process, Genome sequencing is the current molecular technology which provides evidence of human selection which acts on various loci. Domestication is the change in wild progenitors to the cultivated genotypes in order to satisfy the human demand by selection for desirable traits of crop plants (Acquaah, 2009). Generally for routine agricultural production and use, wild relatives of domesticated species do not retain entirely the necessary characters. The method in which wild species are taking in human management is known as domestication. It came into existence when man began agriculture ~10,000 years ago. In the future domestication continue for a long time of wild species and its happening now also. This is because; human needs are likely to change with the time. Subsequently, today the wild species which shows very less importance, tomorrow they may take up great worth.

From the wild weedy species, the existing plants which are cultivated have been derived. The primitive man has domesticated many crops. The primitive man must have chosen those plant traits which he found more suitable for his basic requirements. In domestication, the crop species have changed considerably as compared to the original wild species. The change is often so great that they are categorized as distinctive species. This huge variation amid wild relatives and cultivated plants was brought about by artificial selection by man accompanied by nature.

Various authors has been analysed the process of plant domestication very broadly (Hildebrand, 2003; Casas *et al.,* 2007; Vaughan *et al*., 2007; Pickersgill, 2007; Ross-Ibarra *et al.*, 2007; Msuya *et al*., 2008). The domestication process in various crop species is studied various workers. For instance in Barley crop it was studied by Pourkheirandish and Komatsuda (2007), in Rice crop it was studied by Sweeney and McCouch (2007) and Sang and Ge (2007), in leafy vegetables it was studied by Dansi *et al*., (2009), in tomatoes it was studied by Bai and Lindhout (2007), in acacias it was studied Midgley and Turnbull (2003), and in yam it was studied by Vernier *et al*., (2003) and Mignouna and Dansi (2003).

1. **BRIEF HISTORY OF PLANTS DOMESTICATION**

The practice of plant domestication is estimated to date back 9000 - 11,000 years. Many crops in present day cultivation are the result of domestication in ancient times, about 5000 years ago in the Old World and 3,000 years ago in the New World. In the Neolithic period, domestication took a minimum of 1000 years and maximum of 7000 years. Today, all of our principal for crops comes from domesticated varieties. A plant whose origin or selection is due primarily to intentional human activity is called as cultigen and a cultivated crop species that has evolved from wild populations due to selective pressures from traditional farmers is called landrace. Landraces, which can be the result of natural forces or domestication are plants or animals that are ideally suited to a particular region or environment. An example is the landrace of rice, *Oryza sativa* subspecies *indica*, which was developed in China. The earliest humans attempts at plant domestication occurred in Asia. There is early evidence for conscious cultivation and trait selection of plants by pre-Neolithic groups in Syria.

By 10,000 BC the bottle gourd plant, used as a container before the advent of ceramic Technology, appears to have been domesticated. The domesticated bottle gourd reached the Americans from Asia by 8000 BC. Cereal crops were first domesticated around 9000 BC in the Fertile Crescent in the Middle East. The first domesticated crops were generally annuals with large seeds or fruits. These included pulses such as peas and grains such as wheat. The Middle East was especially suited to these species; the dry-summer climate was conducive to the evolution of large-seeded annual plants and the variety of elevations led to a great to a great variety of species. As domestication took place humans began to move from a hunter-gatherer society to a settled agricultural society. This change would eventually lead, some 4000 to 5000 years later, to the first city states and eventually the rise of civilization itself. Domestication was gradual, a process of trial and error that occurred slowly. Over time perennials and small trees began to be domesticated including apples and olives. Some plants were not domesticated until recently such as the macadamia nut and the pecan. In different parts of the world very different species were domesticated. In the Americas squash, maize, beans and cassava which has formed the core of diet.

**III. CHANGES DURING THE DOMESTICATION PROCESS**

The book authored by Simmonds (1979) ‘Principles of Crop Improvement’ in which he said that ‘the genetic changes which is obtained by scientific breeders for 100 years is probably very less as compared to changes obtained by farmers for more than 9,000 years. Table 2 indicates that many numbers of changes occurs in crop species both at genetic and physiological make-up. Many of them were due to unconscious selection as a consequence of harvesting and planting and some of them like increases in colour and palatability which are due to conscious selection.

Harlan *et al*. (1973) recognized complete pattern of characters (Table 2) which are correlated with chance selection which owing to broadcasting and harvesting of grain crops. Zohary (1989) also observed the alike patterns for legume crops similar to Harlan *et al*. (1973). Harvesting give rise to the selection of the more determinate growth, non-shattering trait, increased seed production and more uniform ripening. Altogether these traits would have increased the probability of collection of seeds and consequently for sowing. Other character which increases the harvests are selection for erect types along with synchronous tillering and the increase in number of fertile florets per inflorescence, size of inflorescences and the number of inflorescences. The increase in rate of germination and seedling vigour causes seedling competition which is due to the planting in close spacing. After prolonged stretches of suboptimal weather at least a few seeds would be available to germinate if the seed dormancy is prolonged. These adaptations were of no use once harvesting of this seed was done and they have been stored away from the natural environment. If the seed size is large it will ultimately lead to good seedling vigour and if there is loss of germination inhibitors it would allow faster germination.

Sometimes the primary reason for domestication changed as humans began to consciously improve a crop (Anderson, 1954). At first the pumpkins and squashes were started out with bitter flesh and small fruits. They may have first been used as dishes and as storage vessels in ceremonies and dances. After some time they used as food. Firstly for their seeds and then for flesh. Other crops that came to have multiple uses include chenopod (seeds and leafy vegetables), hemp (oil, fibre and stimulation) and flax (oil and fibre). The famous example is of *Brassica oleraceae* the flowers of which is used as broccoli and cauliflower while its leaves became cabbage, kale and Brussels sprouts and kohlrabi became its fleshy corms (Thompson 1979; Helm 1963; Gray 1982; Song *et al* 1990). Local adaptations have slowly increased over time as humans started to plant the same field every year and started to save the seed of grain crop. Synthetic population of 28 universal barley varieties were used by Clegg *et al* (1972) to study the evolutionary change. In 1929, he has sown the mixture of seeds in large plot and without any artificial selection the population was allowed to reproduce by natural crossing. Random sample of seeds were collected from it and they were sown annually. The dramatic changes in gene frequency were documented over ensuing decades which subsequently resulted in high grain yield with more stability in yield along with more compact, heavier spikes with larger numbers of seeds (Allard, 1988).

**Table 1. Characters generally related with the domestication process**

|  |  |
| --- | --- |
| **Sr. No.** | **Characters** |
| 1 | Reduction of toxicity |
| 2 | Increase in number of seeds and fruits |
| 3 | Reduced complexity of reproductive organs |
| 4 | Change in life cycle |
| 5 | More uniform ripening period |
| 6 | Non-dehiscent fruits and seeds |
| 7 | Self-pollination |
| 8 | Change in biomass allocation |
| 9 | More uniform timing of germination |
| 10 | Improvement in the productivity of the economic plant part |
| 11 | Change in quality of produce in terms of colour, taste, texture and odour |
| 12 | Increased palatability |
| 13 | Higher germination rates |
| 14 | Loss of defensive structures |
| 15 | Greater germination predictability |
| 16 | Increased size of reproductive organs |

(Source: J.F. Hancock (2004). Plant evolution and the origin of crop species, Page 161)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

**Figure 1.** Different evolutionary phases of domestication and diversification in maize



(Source: Courtesy of J. Doebley, the University of Wisconsin–Madison, USA)

**Table 2.** **Adaptation syndromes resulting from natural selection in seed of cereals**

|  |  |  |
| --- | --- | --- |
| **Selection pressure** | **Response** | **Adaptation** |
| Harvesting | Enhanced seed shattering % | Non-shattering |
| More determinate growth |
| Seed production increase | Increase in seed set |
| Reduced or sterile flowers become fertile |
| Increase in inflorescence size |
| Increase in inflorescence number |
| Seedling competition | Improved seedling vigour | Increase in seed size |
| Reduction in protein content of seeds |
| An increase in carbohydrate |
| More rapid germination | Reduction in inhibitors of germination |
| Reduction in glumes and other appendages |

(**Source:**  J.R. Harlan, J.M.J. deWet and E.G. Price, 1973, Comparative evolution of cereals, Evolution 27, 311–325).

**IV. PURPOSE OF DOMESTICATION**

The man has brought wild plants under his control for various purposes. Plants have been domesticated primarily for five main purposes viz., food, clothes, shelter, medicines and aesthetic value.

1. Food - Those plants which are domesticated for large-scale food production are generally called crops. Such plants include food grains, vegetables and fruit crops

2. Clothes - Those plants which are domesticated for large-scale crop production are referred as fibre crops. Such plants include cotton, jute, sunhemp, kenef and other fibre yielding plants 3. Shelter - Those plants which are domesticated for large scale wood production are known as Timber trees. Such plants are grown for use in house for windows, doors and furniture.

4. Medicine - Those plants which are domesticated for large-scale medicine production are called medicinal plants. These plants are used for treatment of various human and animal diseases

5. Aesthetic - Those plants which are domesticated for decoration purposes are known as ornamental plants. Such plants are grown in and around the home and are usually called house plants and ornamentals.

Domesticated plants are divided into two groups, viz. altered and unaltered. The first group includes those domesticated plants that have been deliberately altered or selected for special desirable characteristics such as crop cultigens and cultivars. The second group includes those domesticated plants that are essentially not different from their wild counterparts, such as most of the forest trees.

**V. LIMITATIONS OF DOMESTICATION**

1. It is a very slow process. It takes hundreds of years to bring a wild plant under domestication.
2. Wild plants have several undesirable traits. Elimination of such traits requires continuous breeding efforts
3. The domestication leads to reduction in the resistance of plants to biotic and abiotic stresses. In other words, domesticated plants are less resistant to biotic and abiotic stresses than their wild counterparts.
4. The domestication makes the plants human dependent for their reproduction

**VI. CENTRES OF ORIGIN**

Vavilov (1951), a Russian scientist and his collegues collected a worth of material for ten years from different regions in the world. Vavilov (1951) found that the entire variability of crop plants collected by his team is centred in eight regions of the world and he named them as ‘Centre of origin’ of crop plants.

1. **Chinese centre:** The area consisting of Central and Western China is considered to be the most important centre. A number of crop plants like soybean, radish, apricot, peach, litchi, citrus etc., are believed to have originated here. It is a secondary centre for waxy maize and turnips also.
2. **Hindustan centre:** Parts of India excluding Punjab but including Burma are said to be the centre of origin of rice, sugarcane, pigeon pea, chickpea, mung bean, Brinjal, arboreum and herbaceum, cottons, hemp, black pepper, indigo and mango. A sub centre Indonesian centre, was also identified where sugarcane, banana and coconut is said to have originated
3. **Central Asiatic centre:** This includes Punjab, Kashmir, Pakistan, Afganistan and South-Western USSR. Crop plants like bread wheat, pea, lentil, sesame, spinach and apple are believed to have originated here. It is a secondary centre for rye also.
4. **Near Eastern centre:** This centre includes countries of the middle-east like Turkey, Iran, Israel, and plants like two row barley, einkorn wheat, linseed, alfalfa, grape etc., originated here.
5. **Mediterranean centre:** located in countries around the Mediterranean sea, barley, beans, durum wheat, cauliflower, cabbage, broad bean and sugar beet originated in this centre.
6. **Abyssinian centre:** Embracing Ethiopia and Eritrea, this centre is for coffee, lady’s finger and sesame.
7. **Central American centre:** Rather an isolated part in south Mexico and neighbouring countries, this was considered as the centre of origin of important crops like maize, beans, chillies, hirsutum cotton, pumpkin and gourd.
8. **South American centre:** this includes Peru, Equador, Bolivia and neighbouring islands and crops like Egyptian cotton, tomato, tobacco, sweet potato, papaya and cashwnut are believed to have originated in this centre. Vavilov (1951) separated two sub centres, 8a, Chiloe centre where potato originated; and 8b, *Brazilian- Paraguayan centre* where groundnut, *Hevea* rubber, pineapple and cashewnut originated.
9. **PLANT INTRODUCTION**

In plant introduction, the group of genotype of plants or a single genotype is to be taken into new atmospheres wherever they have not grown previously. Introduction might include novel varieties of a crop which are already grown in the area, a totally new crop species or wild relatives of the crop species. Generally from other countries or continents, materials are introduced. However within a country, movement of crop varieties from one environment into another is also called as introduction. Certain instances of introduction in the country are popularization of grape cultivation in Haryana, Introduction of wheat in West Bengal, Rice in Punjab etc.

1. **Primary Introduction**: An introduction is said to be primary introduction when the introduced variety is compatible to the different atmosphere, for commercial cultivation, it is released without any change in its original genotype. Primary introduction is not common. There are some examples of primary introductions like varieties Sonora 64, Lerma Roja are the semi dwarf wheat introductions and IR-8, IR-36 and Taichung Native 1 (TN-1) are some of the semi dwarf rice varieties.
2. **Secondary Introduction:** To isolate a superior variety, the introduced variety may be subjected to selection. Instead, to transfer one or few characters from this variety to the local ones, it may be hybridized with local varieties this process is termed as secondary introduction. Secondary introduction is very common than primary introduction. Kalyan Sona and Sonalika wheat varieties are some instances of secondary introduction.
3. **HISTORY OF PLANT INTRODUCTION**

From centres of origin, crop plants have gone into several new areas. The movement of man leads to movement of plants. Many introductions were happened too early in the past. From the Central Asian Centre of origin several crops such as mung bean, mustard, apple, pear and walnut has been introduced into various parts of India. Likewise in prehistoric period crops like pigeon pea, Sasamum, sorghum, finger millet and Asian cotton has been originated from Africa to India. The plant introduction was happened through various traders, settlers, explorers, travellers and naturalists before many decades. It was made not only through knowingly but also unknowingly.

Muslim invaders which were belonged to Afghanistan introduced grapes and cherries to India from Afghanistan by 1300 A.S. Portuguese introduced cereal crop like maize, oil crop like ground nut, solanaceous crops like potato, tobacco, Chillies and sweet potato to India in 16th century. Also in the same century they brought fruit crops like Guava, Cashewnut, Papaya and Pineapple to India. East India Company brought loquat, litchi and tea from China to India. Vegetable crops like Cabbage, cauliflower and other vegetables were brought to India from the Mediterranean; in the 18th century crops which were introduced to India from West Indies are Annatto and Mahogany. Again during 19th century, many botanical gardens frolicked a key part in plant introduction.

In 1781, there was an establishment of Calcutta botanic garden. The Kew botanic gardens, England has played an important role in introduction of quinine and rubber trees from South America into India. Several agricultural and horticultural research stations were established during and after the last part of 19th century in the country. The absence of harmonization amid the agricultural and horticultural organizations has been occurred in terms of their introduction activities.

1. **PLANT INTRODUCTION AGENCIES IN INDIA**

In 1946, at the Indian Agricultural Research Institute (IARI), New Delhi a centralized plant introduction agency was initiated. In the Division of Botany, the agency began as a plant introduction scheme and was financed by ICAR. During the second five year plan in 1956, the scheme was expanded as the Plant Introduction and Exploration Organisation. Then in 1961, a separate Division of Plant Introduction was made in IARI. In 1976, the division was renamed as National Bureau of Plant Genetic Resources (NBPGR). The bureau has the responsibility of the introduction and maintenance of agricultural and horticultural plants germplasm.

There are some other agencies concerned with plant introduction along with the National Bureau of Plant Genetic Resources. One of the institution is Forest Research Institute (FRI), Dehradun, which play an important role in the introduction, maintenance and testing of forest trees germplasm. Another such organization is the Botanical Survey of India (BSI). It was established in the year 1890. It was responsible for the introduction, testing and maintenance of plant materials of botanical and medicinal interest. Nevertheless right now, introduction and improvement of medicinal plants is actually observed by NBPGR. For various crops, e.g. Tobacco, sugarcane, potato, tea, coffee, rice etc., Central Research Institute introduce, test and maintain plant materials of their interest. But NBPGR coordinates their actions; NBPGR has the final duty for introduction activities. Individual scientists, universities and other research organizations can also done the introductions of plant materials. However in India, all the introductions must be routed through the NBPGR, New Delhi.

1. **The National Bureau of Plant Genetic Resources (NBPGR)**:

In the 1930, Dr. B. P. Pal of Indian Agricultural Research Institute (IARI) had approached to Indian Council of Agricultural Research (ICAR) in concern with set up of a unit for the assembly of global germplasm. The ICAR scheme initiated it’s working in 1946 in the Botany section of IARI. The first operational scientist was late Dr. Harbhajan Singh. The scheme was expanded into plant introduction and exploration organization in 1956 and as a separate division of Plant Introduction in 1961. In 1976, it was further elevated to the status of the independent institute of ICAR, designated the National Bureau of Plant Introduction. In 1977, it was renamed as the National Bureau of Plant Genetic Resources (NBPGR) with its headquarter at New Delhi.

The NBPGR is now the central body for collection, introduction, organising expeditions, exchange and distribution of seed material and other plant propagules of agri-horticultural crops. By 1978, NBPGR had imported 6,50,000 and exported 2,10,000 accessions of plant material. Besides it sent 7,50,000 accessions to different institutions in the country (Hardas, 1978).

The collected material is thoroughly described for plant characters. Data would be stored and handled with the help of computers. Since documented information on germplasm would be available with the computers, germplasm with any type of plant character can be quickly searched in the store. Material would be stored in gene bank being established at NBPGR for long term storage and future use. Besides, NBPGR also assesses the utilisation of introduced material, coordinates the work of other agencies and imparts training in plant collection, introduction and maintenance. NBPGR has four sub-stations.

1. Simla, Himachal Pradesh – This substation carries out explorations for germplasm collection in the northern hills. Acclimatization of material introduced from temperate countries and high altitudes is also done here.

2. Jodhpur, Rajsthan – Exclusively meant for exploring and acclimatising plant material for the arid zone, this centre is located at the Central Arid Zone Research Institute.

3. Akola, Maharashtra – This sub-station carries out plant explorations in the central zone of India besides acclimatising and multiplying of introduced material for that zone. It is a mixed climatic zone. It was shifted to Akola from Amravati recently.

4. Shillong, Meghalaya – This is a recent addition to the regional centres. This centre has been created for the collection of germplasm from North- East India which has been reported to be a reservoir of genetic variability of many plants including rice, citrus, maize etc.

**Functions of NBPGR:** The required germplasm is introduced from other agencies in India or from other countries. NBPGR arranges the different exploration tours to collect valuable germplasm outside and inside the country. All introduced material of plants is under the quarantine and inspection of NBPGR. From various sources, the multiplication, testing and maintenance of germplasm is to be done. The bureau itself can be done this at one of its substations otherwise by any of the concerned Central Institutes of ICAR. The requested germplasm supply by various scientists or institutions is to be done by NBPGR. If the germplasm is not available in bank it may be procured from other countries by the bureau.The agency is helpful in maintaining all the records related to variety name, plant name, propagating material, date, special characteristics and other important information of the received material. It also helps in providing germplasm to its equivalents or further organizations in other nations. For publication of exchange and collection lists, the Food and Agriculture Organisation (FAO) published an Introduction News Letter with such lists since 1957 at irregular intervals. Some lists have also published by NBPGR and they are in the process of publishing some other catalogues. For the endangered plant species, NBPGR helps in setting up the gene sanctuaries. It also plays an important role inimprovement of aromatic and medicinal plants.

1. **Forest Research Institute (FRI), Dehradun –** The plant introduction organization set up at the institute looks after the introduction, acclimatization and testing of forest trees. It also looks into the conservation of various forest trees.
2. **Botanical Survey of India (BSI) –** It wasestablished in 1890, this body continues to introduce medicinal plants and plants of botanical importance.
3. **USES OF PLANT INTRODUCTIONS**

Plant introductions are utilized in crop improvement in three main ways *viz*., it can used directly as a variety, can be used as a variety after selection and as a parent in the hybridization for the development of improved variety.

1. As a parent in hybridization- Introductions are widely used as parents in the hybridization programmes for the development of new varieties in almost all important agricultural and horticultural crops. For example, all semi-dwarf varieties of wheat and paddy have been developed through the use of introduced material. Many varieties and hybrids in maize, Sorghum and pearl millet have been developed involving introduced material as one of the parents. The pioneer cotton hybrid H4 has been developed from a cross between Gujarat 67 x American nectariless. Here the male parent is an introduction from America. Many other such examples can be cited.
2. As a new variety after selection - Sometimes the introduced material is not found useful as such. In such case efforts are made to develop new ideas through selection. There are several crops in which new varieties have been developed through selection from introductions. For example, in Egyptian cotton, variety Sujata was released after selection from the Egyptian variety Karnak, in American cotton variety, PRS 72 was released after selection from Russian material, in wheat varieties Kalyan Sona and Sonalika are the result of selection from Mexican wheat introductions. Similarly, new varieties have been developed through selection from the introductions in pearl millet (improved Ghana), cowpea, radish, sweet potato and many other crops.
3. As a variety- In some crops, the introduced material is directly released as a new variety. Examples of direct release of introduced material in India, include semi-dwarf varieties Sonora 64 and Lerma Rojo in wheat, semi-dwarf Taichung Native 1, IR 8, IR 20 and IR 36 varieties in paddy, Bragg and Lee varieties in soybean. There are many more examples where introduced the material was found of direct use and released as new variety for commercial cultivation.
4. **PROCEDURE OF PLANT INTRODUCTION**

Introduction comprises of the following stages, procurement, quarantine, cataloguing, evaluation, multiplication and distribution.

1. Procurement: In India, germplasm can be introduced by any individual or institution. But through the NBPGR, New Delhi all the introductions must be sent. For plant introduction, there are two ways. In first method, the individual or the institution makes a straight demand to an individual or institution overseas, who has the desired germplasm, to send it through the NBPGR, New Delhi. In second procedure, a requirement of germplasm is to be submitted by the individual or institute to the NBPGR with a request for their import.

2. Quarantine: To prevent the spread of diseases pests to keep materials in isolation is called as quarantine. Inspection of weeds, diseases and insect pests for contamination of all the introduced plant propagules is done. To dispose of the contaminated material one should give the fumigation treatment or other treatments. If there is a necessity of taking observation of diseases, insect pests and weeds, the materials are grown in isolation. The whole procedure is termed as quarantine and the rules suggesting them are called as quarantine rules.

3. Cataloguing: An entry number is given to the introduction when it is received. Additional, information about species name, origin place, variety, adaptation and its several features are recorded. The plant materials are categorized into three group viz., the prefix ‘EC’ is given to Exotic collections. The prefix ‘IC’ is given to Indigenous collections and ‘IW’ is marked as Indigenous wild collections

4. Evaluation: For the assessment of performance of new introductions they are evaluated at different substations. The evaluation and maintenance of crops like potato, sugarcane, Tobacco, rice etc. is done under Central Research Institutes. The diseases and pests resistance is assessed in hot spots which is the endemic site for particular disease or pests.

5. Multiplication and Distribution: After the necessary trials, favourable selections from the introductions may be increased and released as varieties. Most of the introductions, however, are characterized for desirable traits and are maintained for future use.

1. **PURPOSE OF PLANT INTRODUCTION**

There are five main purposes for plant introduction like, economic use, study of origin and evolution of crop plants, conservation of diversity, genetic improvement of crop plants and aesthetic interest. These aspects can be briefly discussed as follows.

1. Study of origin and evolution- Plant introduction also helps in the study of origin and evolution of crop plants. The distribution of crop plants and their wild relatives in different geographical regions proves light about their geographical origin. Based on collection of crop plants from different regions of the world, Vavilov gave idea of centres of origin of cultivated species and other workers identified progenitors of different crop plants.
2. Conservation of diversity – The genetic diversity of crop plants is gradually being eroded due to clear cultivation, deforesting, development of Township and various other factors. Introduction and collection of Crop plants is useful in conservation of crop genetic diversity and saving certain species from extinction.
3. Economic use – Various agricultural crops are introduced for use as new sources of food, vegetables, oil, fibre, wood or timber and fruits. In other words in field crops, horticultural crops, forest species and medicinal plants are introduced from other countries.
4. Aesthetic interest - Various flowering plants are introduced for beautification of parks, gardens, houses, offices and bungalows in big cities. New ornamental plants are introduced for this purpose.
5. Uses in hybridization - New plants are also introduced for genetic improvement of Crop plants. Introduced material is used in breeding programmes for transferring desirable characters to the cultivated species. TN1 or IR 8 are the varieties with dwarfing gene from Dee-geo-woo-gen. In the crop tomato, cross between Meeruti and Sioux is Pusa Ruby tomato. Pusa Early Dwarf is the result of cross amid Meeruti and Red Cloud. Pusa Kesar carrot and Pusa Kanchan turnip are also the results of hybridization in the introduced material.
6. Entirely new crop plant or new variety of a crop plant – The various crops like potato, tomato, tobacco, maize are some of the introductions from the wild cultivars which are very old but the crops like oil palm, soybean and gobhi sarson are newly introduced crops. Under the examples of new varieties of crops include semi-dwarf varieties of Mexican wheat includes Lerma Rojo and Sonora 64, while semi-dwarf rice varieties are IR-8, IR-36 and TN 1 which are developed completely as new varieties in particular crops.

**XIII. MERITS OF PLANT INTRODUCTION**

1. This method is used for introducing new crop plants. For example, crops like maize, potato, tomato, groundnut, papaya, pineapple, triticale, etc. were introduced in India from other countries.
2. It is very cheap and quick method for developing new varieties especially when introduced material is used directly as a variety after selection.
3. This is an effective method of conserving those crop species which have been threatened by the danger of extinction. Such species can be saved by shifting them to other areas.
4. This method is applicable in all self-pollinated, cross pollinated and vegetatively propagated crops.
5. This is a good method of collection and conservation of germplasm of different crops to protect the same from genetic erosion.

**XIV. DEMERITS OF PLANT INTRODUCTION**

The introduction of weeds, diseases and pests are some of the disadvantages of plant introduction.

**Diseases:** Late blight of potato caused by *Phytophthora infestans*, got introduced in India in 1883 along with some potato accession and now it is the most dangerous disease of potato. Bunchy top of banana, introduced in 1940, is causing serious losses. Fire blight of apple and pear, caused by *Erwinia amylovora* got introduced from England in 1940 and is now problem disease in the northern hills. Leaf disease of coffee caused by *Haemileia vastatrix* came to India in1876 from Sri Lanka and is causing serious losses

**Pests:** Potato tuber moth entered in India in 1900 from Italy and is widely distributed in the country. Fluted scale became a serious pest of citrus after 1928 when it entered India from Australia probably through Sri Lanka. Wooly aphids, a serious pest of apple in North India now, are also an introduced one along with some apple accession.

**Weeds:** Prickly pine (*Argemone mexicana*) became a popular and problem weed which entered the country through some foreign accession. *Lantana camara* was introduced from Australia by the British for ornamental purpose. Now this is the most problem bushy weed of the northern hills which not only poisons grazing cattle but also has replaced grazeable grasses from the hills. Singly, this weed has done maximum damage to cattle and forest. *Phalaris minor* has become the major problematic weed of wheat after getting introduced from the USA. Weeding is not possible in the beginning due to its morphologic similarity with wheat and later roguing becomes very costly.

**XV. ACCLIMATIZATION**

‘When there isadaptation of a variety to a new environment is generally said to be acclimatization’. It can also be defined in other words as when a plant or animal adjusts in a variable environment like, change in altitude, humidity, temperature, pH or photoperiod. It is moreover termed as acclimation or acclimatization is permitting a variety to maintain performance through a variety of environmental conditions. Usually, the introduced varieties are often not adapted to the new environment and because of it they perform poorly. Sometimes, with the number of generations grown there, the performance of a variety in the new environment improves. For acclimatization to occur in the original population, variability must be present. Thus, purelines are not likely to get acclimatized, while land varieties do.

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