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

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**ABSTRACT**

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. Domestication is usually said to be the end-point of a continuum which starts with wild plants exploitation. The process of crop domestication is driven by different agricultural practices, human selection and agricultural environments. 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. During the second five year plan in 1956, the scheme was expanded as the Plant Introduction and Exploration Organisation. When a plant or animal adjusts in a variable environment like, change in altitude, humidity, temperature, pH or photoperiod is known as acclimatization. The chapter gives the total information of domestication, plant introduction and acclimatization.

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

1. **DOMESTICATION**

 According to Pourkheirandish and Komatsuda (2007), plant domestication is the evolutionary process whereby a population of plants becomes habituated to human provision and control. At the dawn of agriculture, approximately 10,000 years ago crop plant domestication began (Harlan, 1992). According to many authors such as Harlan (1992), Zohary and Hopf (1993), 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. 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 of crop domestication is driven by different agricultural practices, human selection and agricultural environments. In the traits like non-shattering seeds or increased palatability which is controlled by different genomic regions reduces the genetic diversity by selection. 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 does 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. Under domestication, the crop species have changed considerably as compared to the wild species from which they originated. The change is often so great that they are categorized as distinctive species. As a result, in many cases, the parental, wild species of the cultivated plants are not definitely known. This great difference between wild relatives and cultivated plants was brought about through selection by man along with nature. The domesticated species were selected for characteristics entirely different from those for which the wild species were selected in nature. Therefore, the two groups of plants developed in two different, often opposite, directions.

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

**II. CHANGES DURING THE DOMESTICATION PROCESS**

The domesticated plants were altered dramatically by humans not only through conscious but also through unconscious selection. The book authored by Simmonds (1979) ‘Principles of Crop Improvement’ in which he said that ‘probably the total genetic change achieved by farmers over the last 9,000 years was far greater than that of scientific breeders in the last 100 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 by-product of harvesting and planting and some of them like increases in colour and palatability which are due to conscious selection.

Whole syndrome of traits which is associated with chance selection owing to the broadcasting and harvesting of grain crops is recognized by Harlan et al. (1973) (Table 2). similar patterns is produced by legumes which is also a result of broadcast seed domestication (Zohary, 1989). Harvesting give rise to in the selection of the more determinate growth, non-shattering trait, increased seed production and more uniform ripening. All of these traits would have increased the probability that the seed of a genotype would be collected and consequently planted. 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 seed were harvested and 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.

As per Anderson (1954), sometimes the primary reason for domestication changed as humans began to consciously improve a crop. 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. Traits commonly associated with the domestication process.**

|  |  |
| --- | --- |
| **Sr. No.** | **Characters** |
| 1 | Increased reproductive effort |
| 2 | Larger seeds and fruit |
| 3 | More even and rapid germination |
| 4 | More uniform ripening period |
| 5 | Non-dehiscent fruits and seeds |
| 6 | Self-pollination |
| 7 | Trend to annuality |
| 8 | Increased palatability |
| 9 | Colour changes |
| 10 | Loss of defensive structures |
| 11 | Increased local adaptations |

(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 automatic selection due to planting and harvesting seed of cereals**

|  |  |  |
| --- | --- | --- |
| **Selection pressure** | **Response**  | **Adaptation** |
| Harvesting | Increase in per cent seed shattered | Non-shattering |
| More determinate growth |
| Increase in seed production | Increase in seed set  |
| Reduced or sterile flowers become fertile |
| Increase in inflorescence size |
| Increase in inflorescence number |
| Seedling competition | Increased seedling vigour | Increase in seed size  |
| Reduction in protein content of seeds |
| an increase in carbohydrate |
| More rapid germination | Loss of or 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).

1. **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 where 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 introduction are popularization of grape cultivation in Haryana, Introduction of wheat in West Bengal, Rice in Punjab etc.

1. **Primary Introduction**: When the introduced variety is well-matched to the new atmosphere, for commercial cultivation, it is released without any alteration in the original genotype, this constitutes primary introduction. It is less common, mainly in countries having well organized crop improvement programmes. There are some examples of primary introductions like varieties Sonora 64, Lerma Roja are the semi dwarf wheat introductions and semi dwarf rice varieties are IR-8, IR-36 and Taichung Native 1 (TN-1).
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 these processes are termed as secondary introduction. Secondary introduction is very common than primary introduction. Kalyan Sona and Sonalika wheat varieties are some instances of secondary introduction which are selected from material introduced from CIMMYT, Mexico.
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. For example, the crops pear, mustard, apple, mung and walnut were introduced from the Central Asian Center of origin into several parts of India. Similarly in Africa crops like Sesame, Jowar, Arhar, Asian Cotton and Finger millet were originated and travelled to India in the prehistoric period. For some eras A.D. the agencies of plant Introduction were invaders, settlers, traders, travellers, explorers and naturalists.

The plant introductions were made not only through knowingly but also unknowingly. Cherries and grapes were introduced in India by Muslim invaders from Afghanistan by 1300 A.S. In the 16th century A.D. crops like Maize, Groundnut, Chillies, Potato, Sweet potato, Guava, Pineapple, Papaya, Cashewnut and Tobacco were introduced by Portuguese. From China, tea, litchi, and loquat crops were brought by East India Company. Vegetable crops like Cabbage, cauliflower and other vegetables were brought to India from the Mediterranean; from West Indies, Annatto and Mahogany are brought in the last quarter of 18th century. A number of botanic gardens played an important role in plant introduction, during 19th century.

The Calcutta botanic garden was established in 1781. Introduction of quinine and rubber trees were arranged by The Kew botanic gardens, England from South America into India. Various agricultural and horticulture research stations were established during and after the last part of 19th century in the country. The various horticulture and agriculture plants were introduced by these stations independent of each other. There was lack of co-ordination amid these organizations about 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 and 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)**:

Dr. B. P. Pal of the then Imperial (now Indian) Agricultural Research Institute (IARI) had approached the then Imperial (now Indian) Council of Agricultural Research (ICAR), in the 1930’s to set up a unit for the assembly of global germplasm. The ICAR scheme started functioning in 1946 in the Botany section of IARI with the late Dr. Harbhajan Singh as first operational scientist. 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, 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 –** Established in 1890, this body continues to introduce medicinal plants and plants of botanical importance.

**VII. 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 pestss .

5. Multiplication and Distribution: After the necessary trials, favourable introductions or 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. Such materials are used in crossing programmes and are readily supplied by the bureau on request.

**VIII. PURPOSE OF PLANT INTRODUCTION**

To improve the plant wealth of the country is the chief purpose of plant introduction. The principal aims of plant introduction may be grouped as below,

1. To obtain an entirely new crop plant: An entirely new crop species may provide by plant introductions. Many crops like, e.g., tomato, potato, maize, Tobacco, etc., are introductions. Soybean, gobhi sarson, oil palm are some recently introduced crops etc.
2. To serve as new varieties: Occasionally introductions are directly released as superior commercial varieties. Sonora 64 and Lerma Rojo are the Mexican semi dwarf wheat varieties, TN 1, IR-8 and IR-36 are the semi dwarf rice varieties are more recent examples of this type.
3. To be used in crop improvement: To develop improved varieties, frequently the introduced material is utilized for hybridization with local varieties. A cross between Meeruty and Sioux is Pusa Ruby tomato which is an introduction from U.S.A.
4. To save the crop from diseases and pests: Sometimes to protect a crop from diseases and pests it is introduced into a new area. To prevent losses from leaf rust Coffee was introduced from Africa in South America. On the other hand, from South America *Hevea* rubber was brought to Malaya to protect it from a leaf disease.
5. For scientific studies: For studies on biosystematics, evolution and origin of plant species, collections of plants have been used. The concept of centres of origin is developed by N.I. Vavilov and also the homologous series of variation.
6. For aesthetic value: To satisfy the finer sensibilities of man, ornamentals, shrubs and lawn grasses are introduced. In social life, these plants are used for adornment and are of great value.
7. Varieties selected from introductions: Through selection, several varieties have been developed from introductions. Kalyan Sona and Sonalika are the two varieties of wheat were selected from introductions were from CIMMYT, Mexico.
8. Varieties developed through hybridization: For the development of crop varieties through hybridization introductions have contributed enormously. from crosses with Mexican semi-dwarf wheat all the semidwarf wheat varieties are derived. Through either TN1 or IR 8 all but few semidwarf rice varieties have the dwarfing gene from Dee-geo-woo-gen. From crosses involving introductions, almost all these semi-dwarf rice and wheat varieties have been developed. From the introduced noble canes, all the sugarcane varieties have been derived. Some other examples of varieties which are developed by using hybridization with introductions are Pusa Ruby tomato obtained from a cross between Meeruti and Sioux; from the cross Meeruti x Red Cloud, Pusa Early Dwarf Tomato, Pusa Kanchan turnip and Pusa Kesar carrot

**IX. MERITS OF PLANT INTRODUCTION**

1. It provides completely novel crop plants.

2. Superior varieties are provided either directly or after selection & hybridization.

3. The only feasible means of collecting germplasm are introduction and exploration and to protect variability from genetic erosion.

4. When the introductions are released as varieties either directly or after a simple selection, it is very rapid and cheap way of crop improvement.

5. To protect the plants from damage they may be introduced in new disease free areas, e.g., coffee and rubber.

**X. 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.

**XI. 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 acclimatation 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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