

# **Centres of origin of cultivated crop plants**

## **Introduction**

The centre of origin is a geographical area where the particular group of organisms (either domesticated or wild) first originated on earth. Many people believed that centres of origin are also centres of diversity. But, the centres of diversity may not represent the centres of origin of crop plants. Although a few species may have been originated separately at more than one place, but most species had their origin at a certain place and then spread elsewhere. In other words, in the centre of origin a crop is generally confined to one place, whereas the centre of diversity may be found at more than one place. The exact location of origin of species is only a matter of speculation based on indirect evidences.

## **Importance of Centres of Origin**

- The information on origin of crop plants is important in plant breeding to locate wild relatives, related species and new genes.
- Knowledge of the origins of crop plants is important to avoid genetic erosion, the loss of germplasm due to the loss of ecotypes and habitat (such as rainforest) and increased urbanization.
- Germplasm preservation is accomplished through gene banks (largely seed collections but now frozen stem sections) and preservation of natural habitats (especially in centers of origin).

## **Concepts of Centre of Origin:**

- The concept of centre of origin was first proposed by The Russian scientist Nikolai Ivanovich Vavilov (1887-1943)
- The Russian scientist Nikolai Ivanovich Vavilov and his colleagues visited several countries and collected a large number of crop plants and their wild relatives.
- One of his missions was to collect crop related germplasm for use in national plant breeding projects.
- They used this collection in Russian breeding programme of developing improved varieties.
- During his exploration, Vavilov observed that crop diversity tends to be concentrated around specific regions

- This concept was against the prevailing view that cultivation of plants started randomly all over the world

### **Centres of Origin**

It is generally accepted that cultivated plants were not distributed uniformly throughout the world. Even today certain areas show far greater diversity than others for certain cultivated crops and their wild relatives.

In 1926, Vavilov proposed that, crop plants are evolved from wild species in the area showing greater diversity and is termed as **Primary centre of origin**. Later, the crops moved to other areas primarily due to human activities, these are areas which generally lacks richness in variation which is found in primary centre of origin.

**Secondary centre of origin-** Areas in which plants shows considerable diversity of forms although they did not originate there.

### **Vavilovian Centres of Diversity:**

N.I. Vavilov (1926, 1951), a Russian geneticist and plant breeder, was the pioneer man who realized the significance of genetic diversity for crop improvement. Vavilov and his colleagues visited several countries and collected cultivated plants and their wild relatives for use in the Russian breeding programme to develop varieties for various agro-climatic conditions of USSR. He considered that great centres of origin were always located in lower mountains and hills of tropical, sub-tropical regions. He stated that plants were not domesticated at random but it was a continuous process.

Nicolai Vavilov (1887-1943) was a Russian scientist who headed the Lenin All-Union Academy of Agricultural Sciences (later named the Vavilov All-Union Institute of Plant Industry in his honor) in St. Petersburg (Leningrad) from 1920 to 1940. He established 400 research institutes that employed up to 20,000 people. He planned to collect all of the useful germplasm that had potential in the Soviet Union, to classify it, and to use it in a national plant breeding effort. He and his colleagues conducted extensive germplasm explorations and collections in many parts of the world. The Vavilov Institute remains an important resource for germplasm maintenance, access, and utilization. In 1926 he published "**Studies on the Origin of Cultivated Plants**" which described his theories on the origins of crops. Vavilov concluded that each crop has a characteristic primary center of diversity which is also its center of origin. Eight areas were recognized and suggested as centers from which all of our major crops were domesticated. Later, he modified his theory to include "**secondary centers of diversity**" for some crops.

**Kinds of evidence that Vavilov used:**

- Archeological
- Plant remains
- Living plants
- DNA, Proteins, Morphology, Biochemistry
- Ecology, Distributions
- Locating the origin of crop plants is basic to plant breeding
- Which allows one to locate wild relatives, related species and new genes (especially dominant genes, which may provide resistance to diseases)

**Based on his studies of global exploration and collection, Vavilov proposed eight main centres of diversity and three subsidiary centres of diversity given as follows:**

1. Main Centres:

**Main centres of crop diversity as proposed by Vavilov are:**

- (i) China,
- (ii) India (Hindustan),
- (iii) Central Asia,
- (iv) Asia Minor or Persia,
- (v) Mediterranean,
- (vi) Abyssinia,
- (vii) Central America or Mexico, and
- (viii) South America.

**2. Subsidiary Centres:**

There are three subsidiary centres of diversity. These are-

- (i) Indo-Malaya,

(ii) Chile, and

(iii) Brazil and Paragua.

All these centres are known as centres of origin or centres of diversity or Vavilovian centres of diversity.

Vavilov could not adequately cover Africa. Moreover, Australia was not covered. These two continents have tremendous wealth of crop genetic diversity of several crop plants.

### **Limitations of Vavilov's views**

The expansion of our understanding on cultivated plants pointed certain limitations on Vavilov's views.

- Vavilov considered the region with greatest genetic diversity of a species as the centre of origin of that species. But now, many such species are known whose centres of origin and genetic diversity are different. For example, Maize and Tomato
- The centres of origin of cultivated plants as per Vavilov are limited to the mountains and small hills in tropical and sub-tropical regions. But recent evidences also suggest plains as the centres of origin of many cultivated plants.
- Today several crops are known whose centres of origin are different from the ones suggested by Vavilov. Moreover there is more than one centre of origin. Also, the origin of many of the species cannot be traced due to lack of sufficient evidence. According to Vavilov primary centre is marked by high frequency of dominant alleles towards the centre and recessive towards the periphery. But this view is not acceptable as per the latest knowledge.

**The main differences between centres of origin and centres of diversity are given below:**

- Centres of origin are geographical areas where crop plants have originated.
- A centre of diversity refers to a location where vast genetic variability for a crop and its wild species is found.

Thus, the centre of origin and centre of diversity for a crop may be same or may be different.

**Types of Centres of Diversity:**

**The centres of crop diversity are of three types viz.:**

- Primary centres of diversity,

- Secondary centres of diversity, and
- Micro-centres.

These are briefly discussed below:

- **Primary Centres of Diversity:**

Primary centres are regions of vast genetic diversity of crop plants. These are original homes of the crop plants which are generally uncultivated areas like, mountains, hills, river valleys, forests, etc.

Main features of these centres are given below:

- They have wide genetic diversity.
- Have large number of dominant genes.
- Mostly have wild characters.
- Exhibit less crossing over.
- Natural selection operates.
- **Secondary Centres of Diversity:**

Vavilov suggested that valuable forms of crop plants are found far away from their primary area of origin, which he called secondary centres of origin or diversity.

These are generally the cultivated areas and have following main features.

- Have lesser genetic diversity than primary centres.
- Have large number of recessive genes.
- Mostly have desirable characters.
- Exhibit more crossing over.
- Both natural and artificial selections operate.
- **Micro-Centres:**

In some cases, small areas within the centres of diversity exhibit tremendous genetic diversity of some crop plants. These areas are referred to as micro-centres.

Micro centres are important sources for collecting valuable plant forms and also for the study of evolution of cultivated species.

The main features of micro centres are given below:

- They represent small areas within the centres of diversity.
- Exhibit tremendous genetic diversity.
- The rate of natural evolution is faster than larger areas.
- They are important sites for the study of crop evolution.