CHANDRA SHEKHAR AZAD UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, KANPUR- 208 002

B.Sc. (V Semester)

GPB-311 (Crop Improvement – I (Kharif Crops) 2(1+1)

Topic: Plant Genetic Resources, Its utilization and Conservation

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Plant Genetic Resources

- Definition

"Germplasm of a crop may be defined as the sum total of hereditary material, i.e. all the alleles of the various genes, parent in s crop species and its wild relatives"

Or

"The sum total of genes in a crop species is referred to as genetic resources or gene pool or genetic stock or germplasm"

Historical Aspects

Sir Otto Frankel coined the term Genetic resources in **1968** to aware the plant breeders of this gradual loss of germ plasm.

1970 In USA initiating action to collect, conserve, evaluate and utilize the plant germ plasm resources ,when southern corn leaf blight was out broke.

Alphonse de Candolle was the first botanist who attempt to locate the origin of crop plants,in 1882 he published a *book "Origin Of Cultivated plants*."

1926 Nikolai Ivanovich Vivelov ,the Russian explorer,genetist and agronomist organized the world wide exploration for collecting the seeds and propagating material of large number of cultivated crops, wild and related species.

1951 Vavilov proposed eight centre of origin and three sub centre of different plant species.

1961 FAO organized the first International technical meeting on plant exploration & introduction.

1968 The Crop Ecology & Genetic Resources Unit (CEGRU) of FAO was established.

1974 International Board Of Plant Genetic Resources (IBPGR) was established in Rome.

1992 IBPGR was transformed to a new autonomous organization International Plant Genetic Resources Institute (IPGRI) to assist the countries (developing).

1905 conservation of PGRs was initiated in India.

1976 NBPGR was established in New Delhi for conservation of various crop species.

CONCEPT OF PLANT GERM PLASM

The sum total of genes in a crop species is referred as to as genetic resources or gene pool Or gene stock or germplasm.

In other word , gene pool refers to a whole library of different alleles of a species.

Germ plasm is the basic material with which a plant breeder has to initiate his breeding programme.

It is the genetic wealth that a crop has acquired over millions of years of its existence under natural conditions or human cultivation and thus provides the raw material for further improvement through natural or human interference.

CHARACTERISTICS OF PLANT GERM PLASM

i. Germplasm represents the elite genetic variability or diversity available in a crop species.
ii. Germ plasm consists of land races, modern cultivars, obsolete cultivars, breeding stocks, wild forms and wild species of cultivated crops.
iii. Germplasm includes both cultivated and wild species or relatives of crop plants.
iv. Germplasm is collected from the centre of diversity, gene banks, gene sanctuaries, farmer's fields, markets and seed companies.
v. Germ plasm is the basic materials for launching a crop improvement programmes.
vi. Germplasm may be indigenous or exotic or alien.

IMPORTANCE OF GERM PLASM RESOURCES

1. Foundation of an effective crop improvement programmes.
2. Genetic diversity is an essential if high level of productivity are to be sustained.
3. Past breeding efforts have largely been based on relatively small samples of
4. locally adapted cultivars, with the result that as that as state of varietal improvement has advanced the genetic base of the crop has become narrower.
5. Only in recent years has it become apparent that plant breeding programmes with a broad genetic base can help to prevent the rapid and extensive spread of pests and diseases and thus sustain high crop yield .
6. In any crop in order to meet the growing need of varietal improvement and to ensure the effectiveness of breeding , it is essential to assemble preserve and develop the entire array of existing germplasm as for as this is available.

KINDS OF GERM PLASM

There are five types of the Germplasm can be explain:-

A.LAND RACES-

These are primitive cultivars which had selected and cultivated by the farmers for many generations.

Characteristics :-

1.They are evolved under subsistence agriculture.
2.High level of diversity.
3.Provide high degree of resistance to biotic and abiotic stresses.
4.It have broads genetic bases
5.Wider adaptability & protection from epidemic of diseases & pests.

B. OBSOLETE CULTIVARS –

These varieties were developed by systematic breeding efforts, were once commercially cultivated.

These are the varieties which were popular earlier and now have been replaced by new varieties.

*wheat varieties K65, K68, Pb 591 were most popular traditional tall varieties before introduction of high yielding dwarf Mexican wheat.

Continue....

C. MODERN CULTIVARS-

The currently cultivated high yielding varieties are referred to as modern cultivars. It is also known as improved cultivars or advanced cultivars.

D. ADVANCED BREEDING LINES-

Pre –released plants which have been developed by plant breeders for use in modern scientific plant breeding are known as advanced breeding lines or cultures or stocks.
They includes advanced cultures which are not yet ready for release to farmers.

E. WILD FORMS OF CULTIVATED-

Wild forms are the wild species from which crop species were directly derived. Such plants have generally high degree of resistance to biotic and abiotic stresses and are utilized in breeding programmes for genetic improvement of resistance to biotic and abiotic stresses.
They can easily cross with cultivated species. *Oryza nivara* and *O.fatua* are wild forms of rice crop.

GENE POOL SYSTEM

WHAT IS GENE POOL ?

A gene pool consists of all the genes and their alleles present in all such individuals, which hybridized or can hybridized with each other.
It includes all cultivated cultivars, wild species and wild relatives.

PRIMARY GENE POOL

Intermating is easy Leads to production of fertile Hybrids.
It includes plants of the same or closely related spp. Which Produce fertile offspring on Intermating
It designated as GP1

SECONDARY GENE POOL

The genetic materials That leads to partial Fertility on crossing with GP1 is called as secondary Gene pool
It includes plants belongs to Related species
It can cross with GP1,but hybrid are sterile & some are fertile

TERTIARY GENE POOL

The genetic materials which leads to production of Sterile hybrids on crossing with primary gene pool is termed as tertiary gene pool.
It includes materials which can be crossed
With GP1 ,but the hybrids are sterile
Transfer of genes from such materials to GP1 is possible with the help of special breeding techniques.

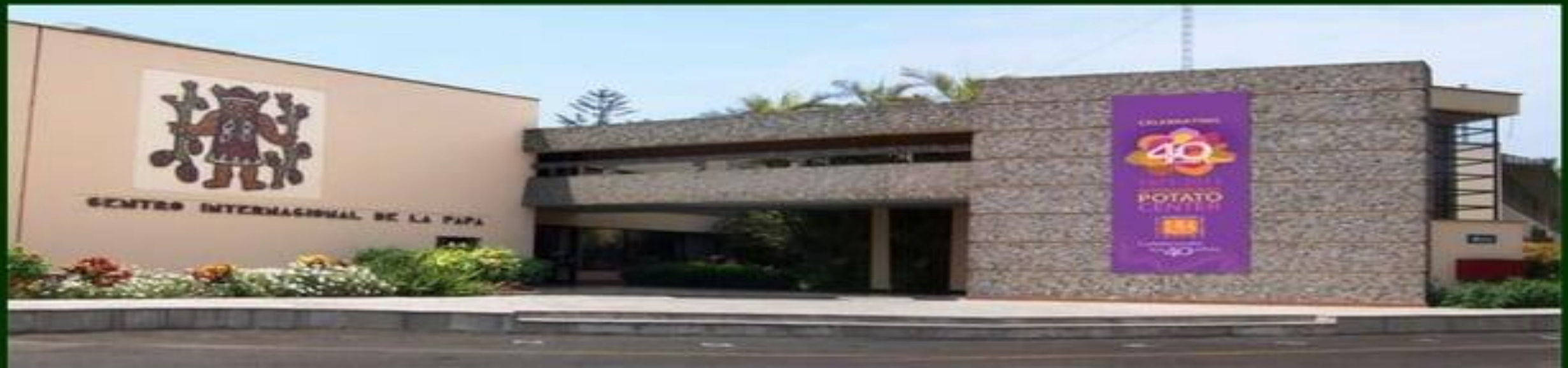
GENE BANKS FOR VARIOUS CROPS

SN	CROPS	CENTRES
1	Wheat	DWR, Karnal
2	Rice	CRRI,Cuttack,IGKV,Raipur
3	Potato	CPRI,Shimla
4	Cotton	CICR,Nagpur
5	Sugarcane	SBI,Coimbatore
6	Tobacco	CTRI, Rajahmundry
7	Pulses	IIPR, Kanpur
8	Forage crops	IGFRI,Jhansi
9	Tuber crops(except potato)	CTCRI,Trivendaram ,Kerala
10	Plantation crops	CPCRI,Kasargod
11	Oilseeds crop	DOR Hyderabad
12	Horticultural crops	IIHR, Bangalore
13	Sorghum	NRC Sorghum ,Hyderabad
14	Soybean	NRC Soybean ,indore
15	Ground nut	NRC Groundnut, Junagarh
16	Maize	IARI, New Delhi

STATUS OF THE PLANT GERM PLASM RESOURCE AT A GLANCE

World –
CIP (International Potato Center, Peru.) founded in 1971, maintains the world's largest genetic bank of potatoes that is 7000 accessions of native, wild & improved varieties.
4300 from Andes and 180 wild potato ,it is bitter to eat.

IRRI, Los Banos,Phillipines- International rice gene bank, the world largest rice genetic diversity that is 110000 different types of rice from all over the world.



GERM PLASM HOLDING IN ICRISAT GENE BANK

CROP	ACTIVE	BASE	ACCESSION HELD IN TRUST
Sorghum	37904	34313	36771
Pearl millet	21594	20343	21563
Chickpea	20140	16977	17124
Pigeon pea	13632	11794	12389
Groundnut	15419	12640	14803
Finger millet	5949	4620	5949
Foxtail millet	1535	1054	1535
Prosomillet	842	576	835
Little millet	466	384	462
Kodo millet	658	630	656
Barn yard millet	743	487	743
Total	118882	103818	113830

The ICRISAT gene bank ,Patancheru, India currently conserves 118882 accessions of the five mandate crops& six small millets from 144 countries.

INDIAN STATUS IN PLANT GERMPLASM RESOURCE

In India, National Bureau of Plant Genetic Resources (NBPGR),New Delhi ,maintains large collections of *Sorghum sp.*, *Pennisetum sp.*, wheat, barley, oat, rice, maize and other agricultural and horticultural crops.

GERM PLASM ACTIVITIES

There are six important activities related to plant genetics resources:

A.Exploration & collection
B.Conservation
C.Evaluation
D.Documentation
E.Distribution
F.Utilization

A. EXPLORATION & COLLECTION

Exploration refers to collection trips and collection refers to tapping og genetic diversity from various sources and assembling the same at one place. This is a highly scientific process.

In India, plant exploration and collection activities have been more systematized after the creation of the National Bureau of Plant Genetic Resources (NBPGR) in 1976, between 1946 to July 1976, a total of 31,235 germplasm collections comprising cereals, millets, legumes, oilseeds, vegetables, fiber yielding and other economic plants including wild relatives, were made.

Process of exploration and collection

Source of collection > Priority of collection > Agencies of collection > Method of Collection >Method of sampling >Sample size

Types of seed collection

Based on the use and conservation seed collections are of three type

Type	Particulars	Conservation upto	Stored at	Moisture content
Base collection	It includes maximum number of accessions available in a crop	long term 50 years or more	-18 to 20˚C hermatically sealed	Seed dried to 5% moisture content & have >85% viablity
Active collection	Germ plasm is actively utilized in breeding programmes	Medium term 8-10 years	0˚C	8%
Working collection	These collection are frequently utilized by breeders in their crop improvement programmes	Short term 3-5 years	5-10˚C	8-10%

EXPLORATION PROGRAMME

a) Planning

b) Making contacts wuth local research organization

c) Gathering equipment and preparation

d) Meeting with local researchers /government

e) Sorting out of collected samples

f) Reporting to the headquarters

g) Preparation and publication of reports

h) Delivering /distributing collected samples

Range of activity- by car cover 100-150 km/day whereas on foot 10 km/day is standard for exploring and collecting the germ plasm .

MERITS OF EXPLORATION AND COLLECTION

1.Collection helps in tapping crop genetic diversity and assembling the same at one place.
2.We got material of special interest during the exploration trips.
3.We come across a new species during the process of collection.

DEMERITS OF EXPLORATION AND COLLECTION

1.Collection of germplasm especially from other countries, sometimes leads to entry of new disease, new insects and weeds.
2.Collection is a tedious job.
3.Transportation of huge collections also poses difficulties in exploration and collection.

B. CONSERVATION

Conservation refers to protection of genetic diversity of crop plant from genetic erosion.

"FUTURE OF OUR NATIONAL FOOD SECURITY DEPENDS ON OUR ABILITY TO CONSERVE BIOLOGICAL WEALTH."

-- *M.S. SWAMINATHAN*

METHODS:
There are two methods of germplasm conservation
A.In-Situ conservation **-- under natural habitat**

B.Ex-situ **--- approaches require collection and systematic long-term storage of seeds outsides the natural habitats of species.**

Components of ex-situ conservation
- **Seed gene bank (at - 20° C)**
- **Cryo bank under liquid (at -165 to -196° C)**
- ***In-vitro* tissue culture bank**

Seed can be conserved under
I.Long term- 50 to 100 years
II.Medium term- 10-15 years
III.Short term – 3-5 years storage conditions

Roberts (1973) has classified seeds into two groups for storage purpose:

Orthodox seeds

Seeds which can be dried to low moisture content and stored at low temperature without losing their viability.
As- corn ,wheat, rice papaya, chickpea etc.

Recalcitrant seeds

Seeds which show very drastic loss in viability with a decrease in moisture content below 12 to 13 %.

C. EVALUATION

Evaluation refers to screening of germplasm in respect of morphological, genetical, economic, Biochemical ,physiological, pathological and entomological attributes.

Why germ plasm evaluation is an essential ?

- To identify gene sources for resistance to biotic & abiotic stresses, earliness, dwarfness productivity and quality characters.
- To classify the germ plasm in various groups.
- To get a clear picture about the significance of individual germplasm.

D. DOCUMENTATION

Documentation refers to compilation, analysis, classification, storage and dissemination of information.

Database management system-relational database management system (RDBMS)
In gene bank RDBMS is used

E. DISTRIBUTION

The specific germplasm lines are supplied to the users on demand for utilization in the crop improvement programmes

There are some trait specific germplasm and wild species introduced in India and distributed by the several centres

Sn	crop	Country	Specific trait	Distribution by
1	*Hordeum vulgare L.* EC 657889	CANADA	Resistant to spot form of neck blotch	DWR, Karnal
2	*Oryza sativa L.* a.EC 659913-14	USA	Improved resistant to sheath blight	NBPGR, CRRI
	b.EC 657109-118	France	Blast resistant	TNAU,
	c.EC 659921	Vietnam	Drought tolerant	NBPGR
3	*Zea mays L.* EC659915-17	Nigeria	Resistant to imp. Disease in low lands	DMR,New Delhi
4	*Glycine max L.* EC638228	USA	Resistant to soybean mosaic	NRC soybean

UTILIZATION OF PLANT GERM PLASM RESOURCES

Expanding the characterization ,evaluation and numbers of core collection to facilitate use in:

1.Increasing genetic enhancement and base broadening effects.
2.Promoting sustainable agriculture through diversification of crop production and broader diversity in crops.
3.Promoting development and commercialization under utilized crops and species.
4.Supporting seed production and distribution.
5.Developing new markets for local varieties and diversity rich products, institution and capacity building.
6.Building strong national programmes.
7.Promoting network for plant genetic resources for food and agriculture.
8.Developing monitoring and early warning system for loss of plant genetic resource for food and agriculture.
9.Expanding and improving education and training.
10.Promising public awareness of the value of plant genetic resources for food and agriculture conservation and use
11.Access to PGRs now based on the principle of "Sovereign rights of Nations" as promulgate under the legally binding conservation of Biological Diversity (CBD),1992
12.Used as a variety, as a parent in the hybridization and also used to tarnsfer resistance to biotic and abiotic stresses.

ORGANIZATIONS ASSOCIATED WITH PLANT GERM PLASM

INTERNATIONAL ORGANIZATIONS:

1.Consultative groups on agricultural research institutes(CGAIR)
2.International Plant Genetic Resource Institute (IPGRI), Rome, Italy.
3.International Potato Centre (CIP), Lema,Peru.
4.IRRI,Phillipines.
5.ICRISAT, Hyderabad ,India

NATIOANAL ORGANIZATIONS :

1.NBPGR,Pusa ,New Delhi
2.CRRI, Cuttack, Odisa etc.


THANK YOU !