**Commercial Plant Breeding (AGS 229C)**

**Topic 1**

**Testing the genetic purity of Hybrids**

The genetic purity is one of the most important aspects of quality control. Seed quality includes good germination, purity, and vigour and seed health. With the increase in seed industry, there has been a refinement in the techniques used for testing genetic purity. Methods for testing genetic purity include different morphological, chemical, biochemical and molecular markers.

**Need of seed purity testing**

• To increase crop production at national level.

• To increase farmers income and standard of living.

• To make IPR (plant breeders right and plant variety protection) part strong.

• For distinctiveness, uniformity and stability (DUS) test.

• Quality control of grains for processing.

• Documentation of genetic resources.

**Morphological methods**

• **Seed morphology**: Characters like size and shape of grain, base of lemma, vertical crease hair, rachilla hair, deviation of lateral dorsal nerves wrinkling of lemma and palea etc. These characters are examined with the aid of suitable magnification. The colour characteristics examined under full day light or light of limited spectrum e.g., ultraviolet light. Scanning electron microscope for studying differences in seed coat surface and its inner structure have also been used in some species.

• **Examination of seedling**: Readings about type of germinations, radical length, cotypedon and first leaf colour.

**• Examination in green houses:** Reading taken in all the stages of germination, growth and reproduction.

• **Grow out test:** The seed sample is sown in the controlled condition with the authentic sample. Genetic purity is determined on the basis of observation made on the plant morphological characters with reference to authentic sample. Genetic purity is always expressed in percentage. According to the official regulation in India, it is pre requisite for seed certification of hybrid of crops like cotton, castor, musk melon and brinjal. The test is required to be conducted for checking the sellers label with respect to genetic purity status of the seed lot under the provision of the seed act 1966. In addition grow out test can be used as measure to judge the efficacy of the certification agency or the inspector. The samples for Grow out test shall be drawn simultaneously with the samples for other seed quality tests in accordance with the prescribed sampling procedure. (500 g for sorghum, wheat, paddy and species of other genera with seeds of similar size; 100g for bajra and jute; 250 tubers/ planting stakes/roots/corms). The minimum population required for taking the observation shall be 400 plants, however, it will also depend on the maximum permissible off-type plants prescribed for the species under consideration in the Indian minimum seed certification standards. The standard sample must not differ significantly in any character and be obtained from the originating plant breeder/ breeding institute and can be stored under controlled temperature and humidity conditions so as to use it each year to sow control plots for cultivars under test.Further quantities of sample must be obtained from the originating plant breeder as and when required. A comparison must be made between the two lots of the standard sample before changing from one standard sample to other. The field plots be grown in two replication following all the recommended package of practices. The results of the grow-out test shall be reported as percentage of oethr species, cultivars or off type plants.

**Chemical methods**

Reaction of seeds to KOH, NaOH, Ferrous sulphate colour, Potassium dichromate, Lugol’s solution, HCl and DDT.

 **Biochemical markers**

 i. Electrophoresis a. Polyacrylamide gel elecrophoresis (PAGE) b. SDS-PAGE c. Isoelectric focusing (IEF) d. Ultra thin layer isoelectric focusing (UTLIEF) ii. Peroxidase test iii. Phenol reaction iv. Serological v. Chromatography a. GLC b. HPLC c. RP-HPL

**Genetic Markers**

Identifying the genetic diversity among the plants through RAPD, RFLP and SSR markers.

**DUS Testing**

Plant variety protection can only be granted in respect of a new plant variety after examination, for that UPOV convention Acts laid down criteria viz., Novelty (N), Distinctness (D), Unifromity (U) and stability (S)- DUS . It is an essential requirement for registration of new variety under PPV & FR Act, 2001. Variety be examined for compliance with DUS criteria needed for registration. It involves comparison of new variety against existing varieties for recording a number of morphological/physiological characters, by growing new and existing varieties side-by-side.

**Distinctness**: Must be clearly distinguishable for at least one essential character from the varieties of common knowledge in India and outside. Essential character is a heritable trait which is determined by one or more genes or other heritable determinants that contribute to the principal feature, performance or value of the plant variety.

**Uniformity**: Uniform, when subjected to the variation that may be expected and allowed due to the specific nature of the reproduction of the crop such as vegetative, self and cross pollinated.

**Stability**: Stable when all essential characters remain unchanged after repeated propagation or a specified cycle of propogation.

**Topic 2**

**Release and notification of variety**

After identification of the best cultures from the segregating generation or any other source it has to undergo the following trials.

**1. Row yield trial (RYT)**

For every 10 row, there will be a check entry and the trial will be non replicated.

**2. Replicated row yield trail (RRYT)**

From the row yield trial, the best cultures will be tested in RRYT along with appropriate check.  The best entries from RRYT will be carried forward to preliminary yield trial.

**3. Preliminary yield trial (PYT)**

Replicated trial conducted with appropriate checks. PYT will be conducted normally for two seasons.  While conducting, PYT, the best entries will be nominated to All India trials also.  Screening for biotic and abiotic stresses will be done during PYT stage.  The best entry will be carried to comparative yield trial.  The entries entered into All India trial will be given project number.  For E.g. sorghum entry will be given SPV (Sorghum Project Variety).  Rice - IET (Initial Evaluation Trial) etc.

**4. Comparative Yield trial (CYT)**

CYT is replicated one conducted with more than one check.  The trial will be repeated for 3 seasons.  The entry proved to be superior in all the 3 seasons will be proposed for multilocation trial (MLT).

**5. Multilocation trial (MLT)**

The entries for MLT will be decided at Crop scientists meet held once in a year.  Each station will propose its own entry.  Based on discussion of merits and demerits of each culture, the entries will be nominated.  The MLT will be conducted at Research Stations of TNAU spread over the State.  The best entries will be proposed for Adaptive Research Trial (ART).

**6. Adaptive Research Trial (ART)**

ART will be conducted at farmers’ field by the Agricultural Department Staff.  The entries for ART will be decided during Scientific Workers Conference (SWC) which will be held once in a year at TNAU.  Both scientists of TNAU and Agri. Dept. Staff will participate.  At SWC, the entries will be fixed and each Joint Director of Agriculture will fix number of trials for his division.  The entries performing well in ART will be proposed for release as a variety.  Each culture has to be tested at least in a minimum of 50 centres spread all over the state.  If a culture is non season bound, it will be tested in all the three seasons.  If it is not so, one or two seasons result is enough.

**7. Variety Release Proposal**

The scientist incharge of the culture will propose the culture for release as a variety.  There is a proforma for variety release.  This proforma will contain all the information about the culture viz., parentage, parent’s morphology, cultures morphology, key characters of the culture for identification, agronomic practices, pest and disease resistance, quality characters and yield trial results.

The variety release proposal will be discussed by Director of Research and Scientists.  After approval the proposal will be presented before Variety Release Committee.

**8. Variety release committee**

It will be headed by Commissioner and Secretary, Agrl. Dept. members will be Director of Agriculture Joint Directors of Agriculture and TNAU scientists.  Besides these, two leading farmers of the state will also be the members.  After discussion, based on merit the VRC will approve it for release.  Then the culture will be released for general cultivation.

**9. Notification of the variety**

For certified seed production, the variety is to be notified by the central variety release committee, Delhi.  After release of the variety for notification purpose the information will be furnished in the prescribed proforma.  At that time details about All India trial will also be furnished.  After notification only, a variety can be multiplied under certified seed production.

**Topic Three**

**Protection of plant varieties and farmers’ rights authority (PPVFRA) ministry of Agriculture, Government of India**

**Introduction**

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| In order to provide for the establishment of an effective system for the protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants it has been considered necessary to recognize and to protect the rights of the farmers in respect their contributions made at any time in conserving, improving and making available plant genetic resources of traditional varieties and  for the development of new plant varieties. Hence the Government of India enacted “The Protection of Plant Varieties and Farmers’ Rights (PPV &FR) Act, in 2001”.**Objectives of the PPV & FR Act, 2001**1. To establish an effective system for the protection of traditional plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants.
2. To recognize and protect the rights of farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new traditional plant varieties.
3. To accelerate agricultural development in the country, protect plant breeders’ rights; stimulate investment for research and development both in public & private sector for the development new of plant varieties.
4. Facilitate the growth of seed industry in the country which will ensure the availability of high quality seeds and planting material to the farmers.

**General functions of the Authority*** Registration of new plant varieties, essentially derived varieties (EDV), extant varieties and traditional varieties;
* Developing DUS (Distinctiveness, Uniformity and Stability) test guidelines for new plant species;
* Developing characterization and documentation of varieties registered
* Compulsory cataloging facilities for all variety of plants
* Documentation, indexing and cataloguing of farmers’varieties;
* Recognizing and rewarding farmers, community of farmers, particularly tribal and rural community engaged in conservation, improvement, preservation of plant genetic resources of economic plants and their wild relatives
* Maintenance of the National Register of plant Varieties and
* Maintenance of National Gene Bank
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**Rights under the Act**

**Breeders’ Rights**

Breeders will have exclusive rights to produce, sell, market, distribute, import or export the protected variety. Breeder can appoint agent/ licensee and may exercise for civil remedy in case of infringement of rights.

**Researchers’ Rights**

Researcher can use any of the registered variety under the Act for conducting experiment or research. This includes the use of a variety as an initial source of variety for the purpose of developing another variety but repeated use needs prior permission of the registered breeder.

**Farmers’ Rights**

A Farmer who has evolved or developed a new variety is entitled for registration and protection in like manner as a breeder of a variety;

* Farmers variety can also be registered as an extant variety;
* A farmer can save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a variety protected under the PPV & FR Act, 2001 in the same manner as he was entitled before the coming into force of this Act provided farmer shall not be entitled to sell branded seed of a variety protected under the PPV&FR Act, 2001;
* Farmers cultivating traditional varieties are eligible for recognition and rewards for the conservation of Plant Genetic Resources of land races and wild relatives of economic plants;
* There is also a provision for compensation to the farmers for non-performance of variety under Section 39 (2) of the Act and
* Farmer shall not be liable to pay any fee in any proceeding before the Authority or Registrar or the Tribunal or the High Court under the Act.

**Registration**

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| A variety is eligible for registration under the Act if it essentially fulfills the criteria of Distinctiveness, Uniformity and Stability (DUS). The Central Government issues notification in official Gazettes specifying the genera and species for the purpose of registration of varieties. | Publications of Authority* Plant variety journal of India
* General and crop specific DUS test guidelines
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| So far, the Central Government has notified 57 crop species for the purpose of registration. The PPV & FR Authority has developed “Guidelines for the Conduct of Species Specific Distinctiveness, Uniformity and Stability,” tests or “Specific Guidelines’, for individual crop species. These include bread wheat, rice, maize, sorghum, pearl millet, chickpea, pigeon pea, green gram, black gram, field pea/garden pea, kidney bean/French bean, lentil, diploid cotton (two species), tetraploid cotton (two species), jute (two species), sugarcane, ginger, turmeric, Indian mustard, karan rai, rapeseed, gobhi sarson, sunflower, safflower, castor, sesame, linseed, groundnut, soybean, black pepper, small cardamom, rose, chrysanthemum, mango, potato, eggplant, tomato, lady’s finger, cauliflower, cabbage, onion and garlic, | * Technical Bulletin
* Gene Bank Manual
* Agro-biodiversity (Hotspots Book (Two Volumes)
* A video CD entitled ‘Seed of Sustenance’ highlighting various provisions of the PPV & FR Act, 2001
* Annual Reports

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**Fees for registration**

Application for registration of plant varieties should be accompanied with the fee of registration prescribed by the authority. Fee for registration for different types of variety is as under:

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| **S.No.** | **Type of variety** | **Fees of Registration** |
| 1. | Extant variety notified under section 5 of the seeds Act, 1996 | Rs.1000/- |
| 2. | New variety /Essentially Derived Variety (EDV) | Individual Rs.5000/-Educational Rs.7000/-Commercial Rs.10000/- |
| 3. | Extant variety about which there is common knowledge (VCK) | Individual Rs.5000/-Educational Rs.7000/-Commercial Rs.10000/- |

**DUS Test Centers**

Authority has 52 DUS test Centers for different crops with a mandate for maintaining and multiplication of reference collection, example varieties and generation of database for DUS descriptors as per DUS guidelines of respective crops. The list of DUS test Centers is available on the official website of the Authority.

**Plant Variety Journal of India**

Authority publishes its official journal “Plant Varieties Journal of India” (PVJI) as a monthly bilingual (Hindi & English) publication and made available to public on the first working day of each month on its official website.

**Certificate of Registration**

Applications which have fulfilled all requirements and have been finally accepted by the Registrar for registration were issued Certificates of Registration. Currently, 305 Certificates have been issued. This certificate is valid for 9 years especially for trees and creepers and is valid for 6 years for other crops. Further, if the certificates needs to be renewed or revaluated it can be extended for 18 years for creepers and 15 years for other crops.

**National Register of Plant Varieties**

National Register of Plant Varieties has been kept at the head office of the Registry, containing the names of all the registered plant varieties with the names and addresses of their respective breeders, the rights of such breeders in respect of the registered varieties, the particulars of the denomination of each registered variety, its seed or other propagating material along with specification of salient features thereof and such other matters as may be prescribed.

**Benefit sharing**

The benefit sharing is one of the most important ingredients of the farmers’ rights. Section 26 provides benefits sharing and the claims can be submitted by the citizen of India or firms or non-governmental organization (NGOs) formed or established in India.

**Rights of Community**

* It is compensation to village or local communities for their significant contribution in the evolution of variety which has been registered under the Act.
* Any person/group of persons/governmental or non-governmental organization, on behalf of any village/local community in India, can file in any notified centre, claim for contribution in the evolution of any variety.