Chapter 1

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Thou Shalt Not Sow Thy Field with Mingled Seeds

(Bible, Lev. 19:19)

You shall not sow your field with mixed types of seeds advises the Holy Bible. The quote sufficiently certifies that the importance of varietal purity was known even in those prehistoric times.

A mixture of genetically diverse seeds cannot lead to a uniform crop production and therefore it is necessary to sow identical type of seeds in fields. In present times Varietal Identification is a prerequisite for assurance of seed quality and therefore yields.

The primitive days of seed testing saw simple methods in varietal purity testing. The visible seed and seedling phenotypes were used to identify variety. However, with the passage of time, the age old methods were modified to be more sensitive than ever before.

The pearl millet (Pennisetum glaucum (L.) R. Br.) popularly known as cattail millet, broom grass, bulrush and pencillaria, is a principal crop of semi-arid tropics (SAT) which encompass 48 developing countries including western and southern parts of India, south-east Asia, periphery of Sahara, much of southern and eastern Africa and some parts of Latin America. Many of these countries are among the poorest in the
world. Approximately 1/6th of the world’s population is living in the semi-arid tropics which is characterised by unpredictable weather, limited, erratic rainfall, and nutrient poor soil (IBPGR and ICRISAT, 1993).

Pearl millet is an indispensable food for millions inhabiting the semi-arid and arid tropics and is more important in the diet of the poor. Flour, grits and whole grains of pearl millet are used to prepare staple foods like unleavened flat bread, cooked whole grains (called rice), thick and thin porridge. Several other preparations use only pearl millet or blends with wheat, rice or pulses (ICRISAT, 1986). Apart from that Pearl millet plants are also a rich source of cattle feed.

Ever increasing population and limitations of SAT zones have led to development and release of hundreds of pearl millet hybrids, cultivars, synthetics, open pollinating varieties and composites. With advent of several types of genotypes, it becomes necessary to develop extensive varietal identification programmes for their accurate identification and maintenance of genetic purity.

The genuineness of cultivar seeds is premier and perennial concern of seed quality control programmes. The presence of large portions of off-type individuals generally results in negative effects on yield, uniformity and quality of marketable product. Therefore, if full dividends sought to be obtained by introduction of new varieties (hybrids etc.), strict attention must be given to the identification of varieties. Hence it is imperative to develop methods for varietal identification programmes, in present context - Pearl millets.

The varietal identification and consequent genetic purity of crop cultivars is generally determined through grow-out tests (Dahiya et al., 1992a). The grow-out tests involve growing a representative sample of seeds in field plots and identifying adult plants on the basis of their phenotype (Arus, 1983).
The genetic purity is 'trueness to type' and cultivars showing confirmity to characteristics of the variety as described by the breeder are said to be as genetically pure. The genetic purity of cultivar is an important aspect of seed quality. The seed used for raising a seed crop should be of known purity.

The genetic purity (true to type) of varieties is constantly threatened by several natural, mechanical and accidental/intentional causes. Occurrence of developmental variations, spontaneous mutations, minor genetic variations, selective influence of diseases, natural crossings with diseased, undesirable and off-types, presence of pollen shedders on male sterile lines, mechanical mixtures during harvest and transport, errarious multiplication procedures, improper maintenance of isolation distances, mishandlings, packing of seeds, mislabellings, intentional adulteration of high and low quality seeds and malpractices of unscrupulous seedmen severely damage genetic purity of cultivars (Kadam, 1942; Arus, 1972, Agrawal and Karki, 1989) and hence the genetic purity of seed lots must be checked thoroughly before their distribution for sowing purposes. Besides this sometimes, genetic purity is required to be re-assessed for some defined purposes as has been listed by Payne (1975). Plant breeders may wish to confirm varietal identity and also may wish to assure that hybridization has been successful or they may be interested in knowing whether their product is free from contamination of other varieties. Sometimes official samples taken for control purposes may be tested to determine the percentage of off type seeds. Reputed and quality-cautious seed companies routinely check the purity of the varieties produced by them to avoid impure seeds with unacceptable levels of contaminations and since now farmers also, after having realized the importance of quality seeds, demand assurance that they are supplied with genuine seeds, it has become urgent problem to tackle down.
The advent of several types of cultivars and their growing popularity, do not find standard grow-out tests all adequate for their (cultivars) identification. This inadequacy could be because of long time periods required by them. Although the grow-out test provides an unique opportunity to examine several morphological markers at a time but as the test makes use of adult plant features, it takes up considerable long time to the extent that sometimes results would not be available to seed merchants until 4 to 12 months after the seeds were received for testing. Secondly, as the plants are required to be maintained in fields for long duration, the environmental effects on expression of morphological traits can not be nullified for e.g. pigmentation could be sometimes the only differentiative marker for distinguishing the cultivars but its development in field conditions is largely controlled by light and temperature (Payne, personal communication). It has been found that some morphological features are more prominent at one time of year than another and samples may therefore be examined several times during the season. In addition, as this testing has to be done outside the seed laboratory, adequate field space is required; besides the labour charges required for long term maintenance of field plots put additional financial pressure on seed programme budgets. Hence there exists tremendous necessity to find out certain short-term, simple, quicker and comparatively inexpensive but equally reliable and reproducible method(s) to assess genetic purity within shortest available time period. The present work is an attempt to identify pearlmillet hybrids and their parents in the mentioned contexts.

Since commercial exploitation of heterosis in pearlmillet at farmer’s field, a number of hybrids have been developed and released. The heterosis in pearlmillet is based on cytoplasmic male-sterile lines and requires technical skills and heavy investments for the production of hybrid seeds. Therefore it is important that genetically pure hybrid seeds reach farmers. Hence it is imperative to distinguish hybrids and their parents so
that various natural, manual and accidental or intentional causes of genetic purity deterioration can be avoided.

Present work involves varietal identification of Pearl millet hybrids and parents, following Morphological, Chemical, Physiological, Hormonal and Biochemical techniques, the potentialities of each of them and their values in commercialization have been discussed in following pages.