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SEED QUALITY ON CROP PRODUCTIVITY AND ECONOMIC IMPORTANCE RESEARCH REVIEW

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ABSTRACT

Every grower has at some point observed the effects of poor seed quality: slow germination, damping-off, poor stands, weak seedlings, and mixed or genetically contaminated lots. Because growers depend heavily on preventative/cultural approaches to promote crop health, vigorous seed can be viewed as the first line of defense against the challenges of cold soil, soil-borne pathogens, and other unfavorable conditions. Selecting appropriate varieties adapted to the area of production with disease and insect resistance, along with other desirable characteristics, is also fundamental to satisfactory crop seed performance and yield. In the past, many organic growers have been reluctant to use organic seed due to issues of availability and pricing. Different crop seeds quality have dissimilar tolerance level of management practices. Quality seed combine with different management practices are essential to improve the physical, chemical and biological properties of seed it control wastage reduce loss to maximize crop yield and profit per unit area. As long as growers can achieve higher profits, they are willing to use quality seed. The key is that the profit from using quality seed must offsets its higher cost. The only way to increase production is by increasing productivity per unit area of land.

KEYWORDS: Crop Productivity, Economic Importance, Seed, Seed Quality.

INTRODUCTION

Seed is the 'tip of the arrow' by which new knowledge is delivered to farmers and the point of entry for complimentary agricultural investment (PASS Strategy Memo). Seed is complex and practical solutions aimed at enabling farmers to access and effectively utilize new and existing varieties in a sustainable and cost-effective manner. Despite being an important source of food and feed, seeds are essentially an important delivery system of genetic information. The case of seed for major food crops, when there is limited varietal out-crossing or quality degeneration, the window for commercial opportunity is often short-lived because of the capacity of seed to quickly and; Gastel et al., 2008). Genetically modified crops may someday alter the market dynamics of commercializing seed by enabling a business model to be based on high margins and low volume.

RESEARCH RESULTS

Seed Quality: Seed quality is a crucial determining factor of yield and quality of crop production. Good quality seed is superior to other standard seed in genetic and physiological purity and is free from seed borne diseases and disorders. The quality of the seeds is determined by the interaction of a number of genetic and environmental factors and climatic changes significantly affect seed characteristics. Production of better quality seeds in an effective and efficient manner is a challenge for increasing food demand. Seed quality is a complex trait and novel research approaches to improve seed quality involve a combination of seed technologies, genetics, and molecular biology. Seed quality, in general, refers to the performance of a seed lot under a wide range of environmental conditions. It is a relative term, expressing the status in comparison with an acceptable standard. In the context of germplasm management, Sackville Hamilton and Chorlton (1997) defined seed quality in terms of effective viability, measured as percentage of seeds that germinate in an appropriate controlled environment.

The long-term maintenance of seed viability, combined with minimum loss of genetic integrity of the sample in question, is of crucial importance for effective conservation and use of plant genetic resources. Although orthodox seeds can be stored for very long periods (Roberts 1973), the potential longevity of a seed depends on its initial quality and the extent to which that potential longevity is maximized depends on storage conditions (Roberts 1992). Several factors, including agronomic and environmental, together with seed handling procedures affect the initial quality of seeds.

Methods to ensure good quality seeds

While production of high quality seeds is crucial to efficient management of germplasm collections, the time and storage conditions from harvest to storage is equally critical and seeds should be processed for storage as quickly as possible and until that time they should be held under controlled conditions such as an air-conditioned room that minimizes pre-storage deterioration. As emphasized, good storage conditions can only delay seed deterioration, but cannot stop the process altogether. The extra cost and time spent to ensure high initial seed quality through improved practices of regeneration and seed handling will repay handsomely in the longer run through increased shelf-life of the seeds.

Hybrid seed varieties of rice, wheat, corn, barley, soybean, and diverse field crops are commonly used in various regions of the world for enhanced crop yield. Modern gene technology methods are being used to modify (GM) crops/seeds genetically to carry one or more beneficial traits such as herbicide and insect resistance, better resistance to drought/waterlogging, and modified nutritional profiles. Research on genetics of seed development and chemistry of seed reserves is an essential need in developing new technologies for seed improvement. The key challenge ahead is the identification and incorporation of beneficial genes and traits into elite cultivars, and development of new approaches to producing Genetically Modified crops to minimize regulatory constraints and increase consumer acceptance (Wimalasekera R., 2015).

In general, immature seeds are known to deteriorate rapidly during storage, and delayed harvesting beyond optimum maturity leads to weathering and loss in quality. Harrington (1972) suggested that seeds under development attain maximum viability and vigor at physiological maturity (defined as the stage when seeds reach maximum dry weight during development) and they begin to age with viability and vigor declining thereafter. There is now considerable evidence from a wide range of crops [e.g., barley (*Hordeum vulgare* L.), rapeseed (*Brassica napus* L.), marrow (*Cucurbita pepo* L.), pearl millet, pepper (*Capsicum annuum* L.), rice, soybean, tomato (*Solanum lycopersicum* L.) and wheat (*Triticum aestivum* L. em Thell)] that seed quality continues to improve even after physiological maturity and seeds attain maximum potential longevity some 1-3 weeks (depending on crop and environment) after the end of the grain-filling period (Pieta Filho and Ellis 1991; Rao et al. 1991; Demir and Ellis 1992, 1993; Zanakis et al. 1994; Rao and Jackson, 1996b; Nkang and Umoh 1997; Mendez-Natera et al. 1998; Demir and Samit 2001; Elias and Copeland 2001; Demir et al. 2002, 2004; Dias et al. 2006; Ozcoban and Demir 2006; Probert et al. 2007).

In order to obtain maximum quantities of high quality seeds, it is also necessary that the bulk of seeds are harvested at the correct stage of maturity. Time of harvest will still be a difficult management decision, especially in crop species with indeterminate flowering habit and sequential maturity and/or in the case of mixtures of genotypes in the same accessions. Time of the day can be important and crops prone to shattering can be best harvested with dew in the morning to minimize seed losses.

Genetic Purity: Genetic purity means trueness-to-type of the seed lot. It is important to assure the genetic identity which makes cultivars distinct. Genetic purity is best evaluated through a field trial in which the percentage of off-types in a seed lot is determined. Seed companies typically conduct variety trials each season to evaluate the genetic quality of contract lots; ideally, the seed lot is evaluated in comparison to the parent stock seed lot and competitors' lots of the same variety. The results of these variety trials are made available to the grower; this information is used as a tool to guide on-farm selection of the plants in the seed crop so the seed produced from that crop is true-to-type (Sabry Elias,et al., 2015).

Genetic purity evaluation can also include screening for transgene (GMO) contamination. Corn and beets, for example, are increasingly tested for the presence of transgenes. Seed companies typically request and pay for the testing, which is conducted at independent labs. The current National Organic Program (NOP) regulations do not specifically require testing of organic seed for GMO contamination but an increasing number of certifiers are requesting testing. Avoidance is the best approach. Seed farmers should avoid planting seed crops in regions where cross contamination is likely, observe isolation distances for cross-pollinating crops, and when available, participate in regional pinning networks (Sabry Elias,et al., 2015). Farmer-based seed production and marketing schemes that undertake seed business with view to make profit (Bishaw et al., 2008) local level to ensure availability and access of varieties and seeds to farmers in the absence of formal sector or in less favorable environments and remote areas. Characteristics by the following:

- Participatory − mobilize and involve small farmers in target environments;
- Decentralized − multiply well adapted and farmer preferred varieties at local levels;
- Business oriented − production is linked to seed demand from local and nearby communities;
- Cost effective − lower transport, marketing and distribution costs, thus reducing seed prices;
- Relevant quality − adopt seed quality standards appropriate to farmer requirements;
- Appropriate technology − use low-cost cleaning/treatment equipment to improve seed quality;
- Sustainability − ensure farmers' empowerment and ownership in seed business;
- Evolution − develops into small, privately owned small to medium scale seed enterprises

Genetic purity testing of hybrid seed

To evaluate the genetic purity of hybrid seed, grow-out-trails (GOTs) have been widely used. It involves the comparison of morphological traits of plants raised from seeds of test sample, with that of genuine samples throughout the crop's growing season but it is time consuming, laborious and depends on season, which delays seed certification program. Hence, biochemical markers (Isozymes) have been utilized for seed genetic purity testing but these are limited in number, influenced by environment, plant type and stage. Hence, an accurate and competent method is required for rapid and cost effective hybrid seeds testing. The alternative to this is the DNA marker, which detect the level of admixtures in a seed lot on the basis of established variations between the cultivars at the level of nucleotide sequences. These differences are not affected at different growth stages, seasons, locations and agronomic practices making varietal identification and genetic purity testing more accurate and reproducible.

In recent times, various molecular marker systems including RFLP (Restriction Fragment Length Polymorphism), RAPD (Random Amplified Polymorphic DNA), AFLP (Amplified Fragment Length Polymorphism), ISSR (Inter-Simple Sequence Repeat) and SSR (Simple Sequence Repeat) have been widely in use for genetic purity testing of seed in many field crops but SSR markers are generally used for assessing the purity of hybrid in many crop plants because of many reasons like simplicity, rapidness, reproducibility and cost effectiveness as compared to other markers. The co-dominant nature of SSRs have advantages of determination of, heterozygosis of the hybrids by the presence of polymorphic parental alleles, which make them suitable marker for testing the hybrid purity against the admixture of selfed seeds as well as off types. The SSR markers have been widely used for assessing seed purity in vegetables like cabbage (Liu et al., 2007a), tomato (Liu et al., 2007b), chilli (Mongkolporn et al., 2004), melon (Liu et al., 2006), squash (Ferriol et al., 2003), cauliflower (Zhao et al., 2012), bunching onion (Tsukazaki et al., 2006), and artichoke (Bianco et al., 2011), Molecular markers are becoming vital tools for cultivar identification and seed quality control in many crops because of time saving, precision, less labour-consumption.

Physical Purity

Physical purity evaluation consists of a purity exam and a noxious weed exam. The purity exam determines the percentages by weight of pure seed, other crop seed, weed seed, and inert matter in a sample. The contracting seed company typically defines the purity standard for a particular seed crop and communicates this standard to the grower. The noxious weed exam determines the rate of occurrence and identity of noxious weeds as specified by the Federal Seed Law. In addition, there is a noxious weed list specified by each state seed law; these weed seeds are prohibited if seeds are to be marketed as "certified seed". These tests are performed by a registered seed technician at a certified lab. Using seed free from weed or other crop seeds, along with planting seed in a clean seedbed, reduces the cost of weed control program (Sabry Elias, et al., 2015).

Other Seed Quality Attributes

Seed viability, vigor, and the presence/absence of seed-borne pathogens or other microorganisms are among the attributes needed to make a reasonable prediction of seed performance in the field.

Viability testing: Viability testing determines the percentage of live seeds in a sample that have the potential to produce normal seedlings under favorable germination conditions. The USDA mandates that all seed sold commercially be tested by a certified lab within six months of sale and must meet minimum germination standards that are set for each major crop group. Individual states have their own seed laws governing viability, so seed companies typically set their own internal minimum germination standards to meet or exceed the strictest of the state laws. One problem with germination testing is that it is ineffective when seeds are dormant (as they won't germinate even when viable). The tetrazolium (TZ) test is a quick biochemical test that evaluates seed viability based on seed respiration. This test is useful as it measures the percent live seeds in a sample regardless of the seeds' dormancy status. The test can be performed in 24 to 48 hours (Sabry Elias, et al., 2015).

Vigor testing: Vigor testing moves beyond a simple assessment of germination by evaluating how quickly seed germinates and whether the germinating seeds and developing seedlings are "normal" and robust in the early stages of growth. Vigor tests measure the potential for rapid, uniform emergence of seeds under a wide range of field conditions. Examples of vigor tests are the cold test, the accelerated aging test, and the conductivity test. The cold test and accelerated aging tests subject seeds to stress conditions to assess their vigor, while the conductivity test measures the level of exudates secreted by the seeds, or the "leakiness," which correlates to low vigor. Level of light and water content from optimum conditions below and above it results wilting and rotting of seedlings (Low and high) finally it affected seed vigor.

Seed-borne diseases and saprophytic (non-pathogenic) fungi: Seed-borne disease testing indicates whether your seed carries diseases that will have a significant impact on the health and productivity of the crop. In addition to seed-borne pathogens, many other non-pathogenic fungi and bacteria can grow on seed surfaces, and high populations can reduce seed viability and vigor. Proper harvest, processing, and storage methods are key to avoiding storage mold in seed lots.

- **Breeder** seed is seed produced by the originating plant breeder or institution/private Company.

- **Foundation** seed is seed produced from breeder seed and is controlled by license from that source.
- **Registered** seed is produced from foundation seed and is the typical parent seed of certified seed.
- **Certified** seed is produced from either breeder seed or foundation seed, and is at most two generations from foundation seed.

Certified Seed: One of the ways in which seed quality is regulated is through adherence to a system of seed certification that is overseen by state seed certification agencies. This system has not typically been used by many smaller, independent specialty seed companies as these companies often have their own internal quality control systems. However, seed certification is an important mechanism for ensuring seed quality and should be understood by growers, buyers, and users of seed. Seed classes indicate how many generations a given seed lot is removed from the plant breeder or institution that was the source of the variety; these classes provide the distributer or buyer information about the history and quality of a seed lot (Sabry Elias, et al., 2015).

Certified seed crops must pass both field inspection and laboratory analysis. The field must be planted from the proper class of seed, have appropriate isolation, and be free of problem weeds and diseases. After harvest, a sample of the seed crop must be sent to an official seed certification laboratory for germination and purity analyses. The seed must meet the standards set by the seed certifying agency. Seed that has passed the field inspection and the laboratory analysis can be tagged as certified seed. In addition to the Certified tag there must also be an analysis tag with information on kind (e.g. corn), variety, and purity (percent pure seed, other seed, inert matter, weed seeds, germination) (Sabry Elias, et al., 2015).

CONCLUSIONS AND RECOMMENDATIONS

Seeds prepared for planting should have high initial quality to ensure highest possible longevity during storage and had highest viability/vigor at germination. A wide range of factors, including agronomic practices, seed production environment, maturity, harvesting and drying practices will affect the initial seed quality and therefore subsequent storage longevity/viability of seeds. In summary, regenerating in suitable environments under optimal conditions, harvesting at appropriate stage of maturity and adopting proper harvesting techniques to avoid mechanical injuries and drying methods that do not adversely affect seed longevity are important considerations to ensure high initial seed quality to the end of seed vigor. Maximizing seed storage life to minimize the frequency un-wanted seeds, both for maintenance of viability and minimizing the cost of operations and in this regard, obtaining good seed curators should be aware of the best management practices that contribute to production of high quality seed.

The only way to increase production is by increasing productivity per unit area of land. Increasing productivity rather than area expansion will be the key factor to meet the increasing demand in the future. Develop and adopt well-informed and open-minded curators for decision who are able to adopt standards and apply new research findings in practice to maximize the seed quality. Seed quality related to germinability, seedling vigor and crop yield final storage; and seed production practices highly depend on the biology and agronomy of the species and sometimes even on the genotypes. Some of the classical methods of seed improvement include coating, pelleting, priming, and production of artificial seed. Development of hybrid seed varieties that adapt to un-favorable climatic conditions and are resistant to a range of pests and diseases are at the forefront of the seed industry in improving crop yield.

The use of quality seed involves two aspects: whether seed of good quality and in large enough quantities can be supplied and whether growers are willing to use quality seed considering the cost-benefit ratio. Both aspects are related to market conditions. The only factor motivating growers to grow is competitive returns. If higher profits can be achieved, growers would be eager to get quality seed, and then seed producers could have a market for their product.

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