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Agri seeds

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ABSTRACT: Seeds present a fundamental role since the beginnings of agriculture, propelling the agricultural development of different people in different ages of human history. Its importance has been linked to the possibility of domesticating the most diverse plants in the past and, nowadays, of providing many biotechnological advancements represented by the most diverse cultivars and hybrids introduced into the market. However, the expression of all its capacities depends on the quality of this supply represented by the sum of physical, genetic, sanitary, and physiological attributes. This review shows how the physiological component of the quality of seeds has influenced the agricultural process for the most diverse crops, notably, for major crops, forages, or vegetables. It is highlighted its central role in fulfilling the growing demands of a growing world population. We emphasize the preoccupation of research, development, and innovation actions in the sense of recognizing the factors that influence the physiological quality of seeds, developing and enhancing methods to estimate, preserve, and increase it, and how the adoption of high physiological quality seeds has influenced the development of the major crops.

KEYWORDS: vigor; yield; major crops; forage; vegetables.

A importância da qualidade fisiológica de sementes para a agricultura Resumo

As sementes representam papel fundamental desde os primórdios da agricultura, impulsionando o desenvolvimento agrícola dos diferentes povos, em diferentes épocas da História da humanidade. Sua importância esteve ligada à possibilidade de domesticação dos mais diversos cultivos, no passado, e, atualmente, são portadoras de inúmeros avanços biotecnológicos, representados pelas mais diversas cultivares e híbridos lançados no mercado. A expressão de todas as suas potencialidades, porém, depende da qualidade desse insumo, representada pelo somatório de atributos, físicos, genéticos, sanitários e fisiológicos. A presente revisão pretende evidenciar como o componente fisiológico da qualidade de sementes tem influenciado o progresso da agricultura para os mais diferentes cultivos, notadamente, para as espécies de grandes culturas, forrageiras e hortaliças, ressaltando seu protagonismo para o atendimento das crescentes demandas de uma população mundial em constante crescimento. Destaca-se a preocupação das ações de pesquisa, desenvolvimento e inovação no sentido de conhecer os fatores que influenciam a qualidade fisiológica das sementes, desenvolver e aprimorar métodos para estimá-la, preservá-la ou incrementá-la e como a adoção de sementes de elevada qualidade fisiológica tem impactado o desenvolvimento dos principais cultivos.

Palavras-chave: vigor; produtividade; grandes culturas; forrageiras; hortaliças.

I. INTRODUCTION

The domestication process of crops and the emergence of agriculture in the history of humanity confer a prominent role for the seeds. Even before the development of agricultural systems, there is archaeological evidence of seeds as food. The humanity experienced in the last two centuries, and more evidently in the last fifty years, advancements in knowledge and technology never seen before in history. It was not different in agriculture. The new technologies have contributed to the increase of yield indexes, which are constantly growing. It becomes difficult to list which discoveries had the most significant impacts in the scenario of modern agriculture compared with that used by our forefathers. However, it is unquestionable the importance of using high-quality seeds independently of the development of new technologies.

Indeed, among the essential processes, there are the discovery of the action of fertilizers and the enhancement of soil management techniques. The development of symbiotic nitrogen fixation significantly reduces the cultivation cost of species of the family Fabaceae (soybean is the main example). We are striving to reach similar efficiency in species of the family Poaceae (Grasses), whose response to the contribution of this mineral is high.

Mendel's discoveries and all the derivations from the genetic enhancement of plants permitted the development of modern cultivars that are productive and adapted to different environmental conditions. In this field, the domain of hybridization techniques has been fundamental to maximize the productive potential, as is the case of corn crops (*Zea mays* L.), by far the most important example. Similarly, genetic enhancement provided new soybean cultivars (*Glycine max* (L.) Merr.) adapted to low latitudes, propelling agriculture in Central Brazil.

In the last century, the development of chemical molecules used for weed, pest, and disease control was essential to increase crop yield. Recently, the modern techniques of Molecular Biology have permitted the development of genetically modified organisms – GMO's, which, in agriculture, are represented mainly by transgenic cultivars, whose adoption in many countries evidence its importance in world agriculture.

The examples mentioned do not minimize the importance of other discoveries. Obviously, if incorrectly used, all and every technique provides risks for the users, and, at the same time, they may be ideologically unacceptable by a part of the population. We do not aim to enter into the merits of these advancements but to present modestly and straightforwardly an evolutive analysis of the changes in agriculture.

Nowadays, to face a growing demand for food of the world population of around 8 billion people, the seeds constitute the starting point of a great deal of the almost 2 billion hectares occupied by the most varied crops that sustain the world agricultural production. In Brazil, grain production increased more than six times from 1975 to 2017, while the planted area was only duplicated in the same period. This change reflects the expressive contribution of the most diverse technological solutions provided by research institutions for agriculture. Such contributions necessarily include the use of high- quality seeds.

Seed quality is understood as the sum of attributes related to the physical and genetic purity and physiological and sanitary quality (PESKE et al., 2009). **For a seed to be considered of high quality, all the attributes mentioned must be in balance and are, therefore, equally important.** The relevance of these attributes is reflected in national and international regulations about the production and selling of seeds around the world. Through normative regulations and other legal devices, minimal quality patterns are required to sell and export seed lots. In the same manner, several associations were created, during the time, to develop methods and to define patterns and criteria to subside the evaluation of seed quality, such as ISTA (International Seed Testing Association), acting in more than 75 countries, AOSA (Association of Official Seed Analysts), in the United States and Canada, and ABRATES (Associação Brasileira de Tecnologia de Sementes), in Brazil.

This review aims to demonstrate that the physiological component of seed quality has been relevant to agriculture advancements. This attribute directly impacts the phase of establishing and unforming crops with the potential to compromise the success of agricultural entrepreneurship or maximize its profit.

The physiological quality of seeds can be defined as the capacity to express vital functions, characterized by germination, vigor, viability, and longevity, parameters that interfere in the performance of the seed under field and storage conditions. The physiological quality of seeds is maximal during physiological maturity when the seed is still attached to the mother plant. For most species, there is the maximal amount of dry matter, which tends to reduce from then depending on the prevailing environmental conditions until the harvest, the harvest procedures, drying, and processing adopted, as well as the storage conditions. The germination of seeds comprehends the succession of many ordered metabolic and biochemical phases that characterize the restart of the embryo development, generating a seedling. The success of this process is higher when there are more favorable conditions to generate it, notably light, temperature, and water and oxygen availability, as well as the efficiency to mobilize energy reserves stored in the reserve tissues of seeds.

Responsible for the differences in the development of seeds under the most diverse environmental conditions, vigor determines the speed and uniformity of germination, emergence, and initial development of seedlings, the ability to emerge under unfavorable environmental conditions, and the germination capacity after storage periods. Vigor is genetically determined and influenced by the production environment of seeds, affected significantly by temperature, photoperiod, water and nutrients availability, and incidence of pests and diseases during the formation of seeds. Delays in the establishment of crops and unevenness in the stand are critical for reduced cycle crops or whose products are individual components of the plants, as occurs with most vegetables, from which are sold their roots, heads, bulbs in different stages of plant development. Nevertheless, in other cases, such coincidences can compromise the main crop competitiveness facing weed development, affecting the productive efficiency and the maintenance of crops. This derives from the fact that there is an ideal relation between the number of plants established in a unit of area (stand) and the production expectation for all crops. Once there are failures in the obtention of an ideal stand, there is a tendency to compromise the tradable production, which is higher when the compensatory capacity of the species to minimize such fails is lower. In the case of major crops, many studies have presented the impact of using low-quality seeds in the initial establishment of the cultivation, whose effects can remain until the most advanced phases of plant development, limiting crop yield.

Seed longevity, by its turn, directly relates to the behavior during storage, which can be defined as the maximal period that a seed can stay viable under ideal storage conditions. The genotype strongly determines this characteristic. By its interaction with environmental conditions emerges the concept of viability, which corresponds to the period that a seed effectively lives within its longevity period. In this sense, besides presenting a genetically determined limit, adverse factors during the development of seeds in field conditions and after the harvest can intensify seed deterioration processes during storage and reduce their viability.

However, it is worth mentioning that the amount of water stored in the tissue of seeds (physical attribute) is directly related to its physiological quality, as it influences the intensity of the metabolic activity of the cell, which affects its capacity to stay viable during the storage period.

Considering the importance of the physiological quality to the seed performance expression, many approaches to estimate this component have been developed. Significant progress has been achieved regarding the standardizing of tests related to the seed germination analysis for most species of economic importance. Similarly, methodologies of different vigor tests have been refined by research groups dedicated to the theme. Besides, the legislation has also looked for adjusting itself to the results of such research, incorporating innovations and adjusting its norms regarding the possibilities of analysis of seeds. An example is the possibility of selling Italian rye-grass seeds (*Lolium multiflorum* L.) in Brazil, based on the results of viability obtained by tetrazolium test, permitted by the new Normative Instruction dealing with the definition of production norms, and identity and quality patterns of seeds of forage species of temperate climates.

Low physiological quality of seeds can affect the expression of gains and genetic advantages obtained by enhancement programs of different crops embedded in seeds, damaging the feedback of research actions responsible for generating and launching onto the market different cultivars and hybrids.

As aforementioned, this impact is more or less pronounced according to the cultivation referenced. Thus, to delimitate the approach of the theme, we chose to subdivide the impact of the physiological quality of seeds in major crops, forages, and vegetables.

II. FINAL CONSIDERATIONS

Identifying more appropriate areas to produce seeds with high physiological quality, incorporating seeds physiological quality, besides yield characteristics, resistance to the main biotic and abiotic stress factors for the genotypes of the physiological quality of seeds for agriculture.

Many advancements were already achieved in seed science and technology. However, many challenges remain related to the need to understand more the biochemical and metabolic factors related to the physiological quality of seeds and their interaction with the production environment.

The use of high physiological quality seeds is a fundamental factor for the success of many agricultural enterprises. It contributes to the economic return wished by producers and the fulfilling of the growing demands in food, fibers, and biofuel production.

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