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Review Article

Review on: Impact of Seed-Borne Pathogens on Seed Quality

Mekonnen Gebeyaw

Department of Plant Science, Mekdela Amba University, South Wolo, Ethiopia

Email address:
mekonnengebeyaw23@gmail.com

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Abstract: Healthy seed plays an important role for the successful cultivation of all types of crops. Crop response to other inputs largely depends on quality seed. It is estimated that good quality seed alone can contribute about 18 to 20% increasing crop yield keepingall the other inputs constant. However, there are many factors that affect seed quality especially health quality of seed such as all biotic and abiotic factors. Among various factors that affect seed health are the seed borne pathogens that not only subordinate seed germination, but also reduce seed vigor resulting in low yield and yield components of all crops. Seed borne pathogens not merely the cause for reduction of germination capability of crop seeds but also responsible for variation of plant morphology in the field and reducing yield up to 15 to 90%. Therefore, it is important to maintain the seed health by using different scientific seed health examination and treatments.

Keywords: Seed-Borne Pathogen, Seed Health, Seed Quality

1. Introduction

1.1. Background of the Review

Seed health quality is referred to as the presence or absence of disease causing organisms with in a seed lot such as fungi, bacteria and viruses, nematodes and insects [8]. Seed health is the most important seed quality parameter because most pathogen initially in the seed may give rise to progressive disease development in the field reducing the commercial value of the crop and imported seed lots may also introduce diseases or pests into new regions. The use of proper seed production practices including seed treatment during seed processing are among the major ways of managing pests and diseases [13].

All over the world, farmers and crop growers have clear demands of the quality seeds that they sow. Firstly; they want the species and variety to be reliable with what they believe they have bought. Secondly; they want that seed to achieve uniform and successful establishment of a weed free crop that will develop with out the incidence of diseases that results from seed borne pathogens [6]. There are many factors that affect seed quality such as all biotic and abiotic factors. Among various factors that affect seed health, the most important are the seed borne pathogens that not only lower seed germination, but also reduce seed vigor resulting in low yield of a certain cropt type [15]. Healthy seed plays an important role not only for successful cultivation but also for increasing the yields of crops. For instance seed-borne pathogens of sorghum are responsible for variation in plant morphology and also reducing yield up to 15 to 90% if untreated seeds are grown in the field [1].

Quality seed is the primary basis of crop production and it is the most important available input factor for smallholder farmers. In most parts of the world, smallholder farmers use their produced seed for next year planting, consequently, they attempt to stock their own produced seed for several months to several years. The seeds are of ten of poor quality, impure and contaminated with pathogen. Seed contamination of pathogens during storage could reduce seed vigor, germination, and cause negative effect on appearance and chemical composition of seeds in addition to accelerate seed

deterioration, it can also inhibit germination, transmission of the pathogen from seed to seedling or main plant leading to reduction in crop yield and threatened sustainable food security [10]. Therefore reviewing and gathering information based on the previous research finding, as well as identifying the knowledge and research gaps beneath the impact of seed borne pathogens on seed quality especially healthy quality is very important.

1.2. Objective of the Review

To review the impact of seed-borne pathogens on seed quality.

2. Review of Literature and Discussions

2.1. Defination of Terms

Seed: It is defined as a complex biological structure consisting of a plant in miniature and food reserves protected by covering coats. A miniature plant possessing a remarkable capacity to ensure that the new individual starts life in the right place at the right time [8].

Seed quality: Seed quality is judged by different end users such as farmers and industries. For instance, farmers expect to obtain high quality seeds that are able to germinate and produce normal seedlings under field conditions [12].

Seed borne pathogens: Any pathogen present in a seed sample that causes either failure of germination of seed or rotting of emerged seedlings or produces other kind of disease symptoms on adult plants may, in a broad sense, be called as a seed borne pathogen. Important seed borne pathogens are various fungi, bacteria, viruses, nematode and phanerogamic plant parasites [3].

2.2. Impact of Seed-Borne Pathogen

The following seed characters and related issues are affected by seed borne pathogens [3].

2.2.1. Reduction in Seed Germination

Seed borne pathogens generally reduce germination capability of seeds. Field fungi may cause weakening or death of embryos while storage fungi slowly kill the embryos of the seeds they invade. Seedlings raised from such seeds lack the normal vigor. Reduction in market value Infected seeds loose their market value due to discoloration and distortion. Wheat seeds infected with fungi *(Tilletia caries. T. foetida, and Neovossia indica)* possess poisonous properties and therefore flour of contaminated seeds is harmful for human consumption. In case of brown leaf spot of paddy *(D. oryzae)* the glumes may be covered with a dense black mass of sporophores and spores. Such grains are undesirable for use as seed and reduce the market value of the produce. Similarly, black point of wheat *(Alternaria ienuis),* black scurf of potato *(Rhizoctonia solanii,* red rot of sugarcane *(Colletotrichum falcatum)* etc. are some important examples which reduce the market value of the produce. Biochemical changes a variety of biochemical changes accompany the infected seeds. In rice *Drechslera oryzae* infection decreases the starch and sugar content of grains between 25 upto 85 and 71 89% respectively. In black gram protein contents may be reduced due to *Macrophomina phaseolina* infection in seed. In red rot of sugarcane sucrose is converted into glucose and alcohol as a result of enzyrnic action of the pathogen (c. *falcatum).* Invasion of stored grains by fungi increase in fatty acids, and reducing sugars, and decrease in non-reducing sugars.

2.2.2. Reduction in Processing Quality

Seed borne fungi have been reported to reduce the processing quality of seeds for milling in wheat and corn. These fungi reduce the quality of seeds used for starch and deteriorate the quality of oil producing seeds as in soybean, groundnut, flax etc. Production of mycotoxins Mycotoxins are a group of toxic metabolites (aflatoxin, rubratoxin, tremotins, zearalenone, trichotheoene, patulin, citreoviridin, citrinin, ochratoxin etc.) produced by fungi including those which have been encountered in stored grains. Consumption of food containing mycotoxins can lead to serious physiological disorders in human beings and animals and such diseases have been grouped under Mycotoxicosis. Some diseases like Alimentary Toxic Aleukia *(ATA)* and Yellow Rice Toxin have appeared in epidemic form in Russia and Japan, respectively.

2.2.3. Transmission of Seed Borne Pathogens

Several respiratory troubles occur in men when they inhale smut spores of *Ustilago maydis, Tilletia caries, Sphacelotheca sorghi* etc. at the time of threshing. A number of diseases have been recorded recently from various parts of the country and there is no doubt that most of them have come with the infected seed material. Seed borne pathogens is transmitted by three different ways [3].

i). externally seed borne pathogens. The inoculums in such cases is superficial and confined to the surface of the seed, usuallyas adhering propagules, *e.g.* spores sclerotia, mycelium, bacteria, nematodes, virus particles etc. Pathogens commonly borne on the surface of the seed include species of *Alternaria, Fusarium, Helmintnosporium, Stemphylium,* many smuts, some rust fungi as well as many others. Contamination of the seed surface, especially by fungi is often detectable by direct observation under the microscope or by examining seed washings. Some common examples are: *Tilletia caries* (wheat bunt), *Sphacelotheca sorghi* (grain smut of sorghum), *Ustilago hordei* (covered smut of barley), *Puccinia carihami* (safflower rust), *Ditylenchus dipsaci* (bulb and stein nematode on alfalfa), *Corynebacterium michiganense* (bacterial canker of tomato) and Tobacco mosaic virus in tomato [3].

ii). Internally seed borne pathogens. The inoculums lie within the tissues *i.e.* these pathogens are carried inside the seed. Dry seeds may look perfectly healthy when examined under a binocular microscope and 'show no external signs of infection. However, 'pathogens-may establish themselves in the various layers which envelop the seed, such as the seed coat, testa, pericarp, endosperm and embryo. Transmission of such pathogens is through vegetative cells, spores, "pycnidia, nematodes or virus particles. Some examples are: *Ustilago nuda* (loose smut of barley), *Ustilago nuda tritici*

(loose smut of wheat), *Colletotrichum lindemuthianum* (bean anthracnose), *Phoma lingam* (black leg of cabbage), *Alternaria zinnia* (alternaria disease of zinnia),"*Ascochyta* spp. (ascochyta blight of pea), *Xanthomonas campestris* pv. *malvacearum* (bacterial blight of cotton), X. *campestris* pv. *campestris* (black rot of crucifers) common bean mosaic virus on french beans, Tobacco ring spot virus on soybean [3].

iii). Concomitant contamination. The inoculum is present as concomitant contamination mixed with seeds in the form of infected plant debris, fungal sclerotia, nematode cysts, seeds of phanerogamic plant parasites, bacterial ooze, infected soil particles etc. This type of pathogen distribution is exceedingly important but frequently overlooked. Disease introduction by such means occurs more often than is realized, as such contamination is difficult to detect. Inocula that produce serious disease outbreaks such as those due to downy mildews, rusts and bacterial diseases may be disseminated on plant debris [3].

2.3. Impact of Seed-Borne Pathogens on Seed Quality

A laboratory experiment was conducted with maize seed samples following blotter method. Nine species of fungi namely Aspergillus flavus, A. niger, Alternaria alternata, Bipolaris maydis, Curvularia lunata, Fusarium oxysporum, F. moniliforme, Penicillium oxalicum and Rhizopus stolonifer were identified. Among the species, the incidence of Aspergillus flavus was higher (27.42%) followed by A. niger (23.47%), Fusarium oxysporum (20.55%), Penicillium oxalicum (18.37%), Rhizopus stolonifer (17.83%), F. moniliforme (17.39%), Curvularia lunata (7.87%), Bipolaris maydis (3.50%) and Alternaria alternata (2.74%). The association of the pathogens with maize seeds were observed as deterioration of seed quality and lowered down the germination rate (maximum 78.74% and minimum 67.97%). The fact that more of the fungal pathogens identified were detected on the unwashed sorghum seeds suggests that such fungi could be surface contaminants [9]. This indicated that the need for seed treatment as a strategy for managing the pathogens. Seed treatment is considered to be a cheap and highly effective means of managing seed borne diseases in crops [14].

Numerous of the diseases that cause reduced yields in sorghum have seed borne phases. Seed borne inoculums therefore, have severe implications for yield, seed production and distribution systems, trade, human nutrition and germplasm. The management of these pathogens during the seed borne phase is considered to be the cheapest disease control strategy. However, effective management can only be implemented effectively if the pathogens are correctly identified [1]. In poor storage conditions, seed borne pathogens are the most important factors which are not only cause the seed aging and deterioration during storage, but also seed and seedling rotting or abnormal production of seedlings in the field. Several reports indicated that the majority of these pathogens that lead to the production of abnormal seedlings are seed-borne fungi. The rate of damage of these fungi depends on their genus and species, rate of density, fungi invaded, environmental conditions, cultivar susceptibility and interaction of these factors on cultural practice [10].

Chocolate spot and Lygus are widely distributed throughout in Africa and pose a threat to faba bean production. Lygus fungus is the main cause of necrotic spots on the seeds. However, Botrytis spp. Can also downgrade the seed quality under optimum weather conditions. The contrasting effect of Lygus and Chocolate spot on seed damage suggests that management practices for both may be required, depending on field conditions. Forecasting Lygus and Chocolate spot population levels based on weather factors coupled with information regarding eco regions, host range, host distribution, topography, and developing economic thresholds will be required to establish robust and sustainable management practices [5].

The quality of used rice seeds in the establishment of normal seedlings is important. The contamination of seeds to seed borne fungi during storage by reducing seed quality affects on seed germination and establishment of seedling. The contaminated rate point of view to seed-borne fungi and also different severity of contaminated seeds to various fungi included Fusarium moniliforme, Bipolaris oryzae, Aspergillus niger, Aspergillus flavus, Penicillium sp., Alternaria padwickii. In examined seed samples, among rice seeds borne fungi, Aspergillus niger and Aspergillus flavus in both evaluated methods [Standard blotter method and PDA method] had the most severity than the other fungi species [10]. A. flavus and A. niger fungi as the most important storage fungi could be active in seed moisture content below 20 percent. By examination on the 25 seed samples of rice in Vietnam mentioned that genus of fungus Aspergillus, Fusarium and Penicillium were the most common fungi. Fungi infecting seeds when they are developing on the plants in the field (field fungi) may reduce the seed quality, and storage fungi can cause serious loss of viability when seeds are conserved in the seed store. Dry and cool conditions during storage may reduce such risks. In order to obtain maximum seed quality, harvesting should be carried out after the seeds are fully mature [11].

Many seed borne pathogens are known to be linked with sorghum seed which are responsible for deteriorating seed quality during storage. Since populations of most of the fungi associated with seeds build up in store, observance of the basic principles of good storage practices is crucial to effective storage of grains, especially on long term basis. The level of moisture content in stored grains affects both its grade and storability and has been designated as an essential pre requisite for microbial activity which enhances the rate of damage [1]. Moreover, seed borne diseases are an important threat to crop yield and quality. At present, in the struggle to control these diseases, large quantities of cereal seed are treated by seed dressing with chemical pesticides. However, an extensive use of pesticides has been found to pose risks for pollution of the environment with sometimes wellknown, Sometimes poorly known consequences, not only for leaving

residuals in food products but also for negative influences on the health of people regularly working with them. Another constraint is the development of pathogen resistance to commonly used chemical compounds. During recent decades, thus, there has been increasing public demand from consumers, politicians, environmental organizations, etc., for non chemical methods of plant pest and disease control [4].

Soybean seeds were in oculated with those fungi using potato, agar and dextrose medium with manitol and incubated for 20hr in 25°C. The colony diameter, index of my celia growth, seed water content, incidence of seed-borne pathogens, physiological potential of the seeds, measured by germination and vigor tests (seed germination index, cold test, accelerated aging and electrical conductivity), and seedling field emergence were determined. The contents of K+, Ca2+, and Mg in the seed and in the soaking solution were also determined [2]. A complete 2×4 factorial design with two seed sizes (5.5 and 6.5mm) and four treatments (control, seeds incubated without fungi, seeds incubated with phomopsis and seeds incubated with colletotrichum) were used with eight (5.5mm large seeds) and six 2+ (6.5mm large seeds) replications. All seeds submitted to PDA medium had their germination reduced in comparison to the control seeds. This diminution was also observed when seed vigor and leached ions were considered. The presence of phomopsis sojae fungus in soy bean seed samples submitted to the EC test may be the cause of misleading results [2].

3. Conclusion and Recommendation

3.1. Conclusion

It is concluded that:

Seed quality plays an important role in the successful cultivation and yield exploitation of acrop species. Crop response to other inputs largely depends on quality seed. It is estimated that good quality seed alone can contribute about 18 to 20% increasing crop yield keeping all the other inputs constant. However, there are many factors that affect seed quality especially health quality of seed such as all biotic and abiotic factors. Among various factors that affect seed health are the seed borne pathogens that not only subordinate seed germination, but also reduce seed vigor resulting in low yield and yield components of all crops.

3.2. Recommendation

It is recommended that;

Healthy seed plays an important role not only for successful cultivation but also for increasing the yields of crops. Seed borne pathogens not merely the cause for reduction of germination capability of crop seeds but also responsible for variation of plant morphology in the field and reducing yield up to 15 to 90%. Therefore, it is important to maintain the seed health by using different scientific seed health examination and treatments.

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