Trends in Life Sciences
An International Peer-Reviewed Journal
www.sciencejournal.in

# STUDIES ON POST-HARVEST DETERIORATION OF WHEAT BY DIFFERENT FUGAL PATHOGENS

**Neha Pathak*, Razia. K. Zaidi and Safiuddin**
Section of Plant Pathology and Nematology, Department of Botany, Aligarh Muslim University, Aligarh, India.
(*Email ID- nehamanilmishra@gmail.com)

## ABSTRACT
Seed pathogens are known to cause appreciable changes in viability and nutritional value of the crop plants and are quite effective in producing large no of damage to the quantitative and qualitative characters of wheat crop which is an important food crop is attacked by a number of pathogens including a large group of fungal member which often take a heavy toll of the crop and render them diseased. Seeds play a vital role in the transmission of these pathogens. It is now well established that seeds of wheat undergo a deteriorative process because of these seed- borne disease. The whole wheat and the wheat based food source which are an important source of dietary antioxidants and have great food and nutritive are lost due to grain diseased. In the present paper an attempt has been made to study the disease causing agents of this important food crop and methods for the treatment of seeds or to check the development of these pathogens which lead to the loss of seed quality. Its viability and vigour and the dietary antioxidants which are present in this important cereal food.

**KEYWORDS:** Carbandazim, Dietary antioxidants, Seed-borne fungi, Wheat.

## INTRODUCTION
Wheat (*Triticum aestivum*) is an important cereal and is cultivated as a food crop in many parts of the country. Whole wheat and wheat based food sources are important source of dietary antioxidants and have the greatest potential to be beneficial to health. Phenolic acids from breakfast cereals possess strong antioxidant activity Aleen J. and Changrun Lu (2000). During recent studies, it has been reported that 100g of edible portion of wheat grain contain 11.5% protiens, 59.40% carbohydrates, 9.70% fats, 10.60% crude fibers and 1.80% ash (Akhtar and Siddiqui, 2003). Along with some abiotic limitations, these protein and starch rich cereal crops are also highly susceptible to various pest and diseases and number of storage grain molds cause considerable losses (Subramanian, 2000). Growing evidence indicates that eating whole wheat foods may produce health benefits, including a reduced risk of coronary heart diseases and certain types of cancers. Kansas state university conducted research which showed that rather than the fibre contained in the wheat, it is the powerful antioxidant which make it so successful in the prevention of colon cancer, and a possible factor in the prevention of diabetes and heart diseases and the scientist may be able to create a modified wheat strain with high level of cancer fighting chemicals. Plants like humans are subjected to many forms of stresses and disturbances including pollutants, different types of pests and pathogens which often attack the important crop plant like wheat and the pathogenic fungi often take a heavy toll of the crop and render them diseased and produce a considerable damage to the quality and quantity of the wheat. Seeds play a vital role in the transmission of disease causing agents. These seed-borne pathogens may cause seed abortion, seed rot, seed necroses, and reduction in germination as well as seedling damage. These agents destroy the quality of stored grains, they can destroy the whole grain or can reduce the quality of wheat based food sources causing damage to nutritional value. Current research on the mycoflora of wheat and the damage caused by it suggests that further research is warranted to determine the losses caused by these pathogens to the potential benefits of this important crop which is a rich source of dietary antioxidants.

## MATERIALS AND METHODS
International rules for seed testing (annonymous, 1996) were followed in the present investigations. For the study of seed mycoflora of *Triticum aestivum*, seeds were collected from Quarsi agricultural farm of Aligarh district of U.P. state. Blotter method and potato dextrose medium have been employed throughout the studies and the mycoflora was detected by the methods as recommended by ISTA with some modifications. Microscopic examination of wheat seeds reveals that seeds of all the wheat possess injuries to varying extent. Detailed examination of the seeds has shown that the seeds can be classified on the basis of the extent of injury into minor cracks, major injuries and cracks with exposed embryo.

**Inspection of the dry seeds:** It is a method to detect the presence of fruiting structures of fungi and the effects of fungi on the physical appearance of seeds.
The fruiting structures of fungi can be in the form of:

Pycnidia, sclerotia present on the seed surface or inside the seed coat.
Sclerotia loosely mixed with seeds.
Individual spores or spore masses on the seed surface.

  

Physical abnormalities include:

Shrivelling of the seed coat.
Reduction or increase in seed size.
Discoloration or spots in the seed coat.

**Blotter method**: It is one of the incubation method to detect the deep seated pathogens where the seeds are plated on water soaked filter papers, and incubated usually for 8 days under 12$^{th}$ alternating cycles of light and darkness. After incubation, fungi developed on seeds are examined under different magnification of a stereomicroscope and identified. The identification of the fungi is based on the way they grow on the seeds on the morphological characters of fruiting bodies, spores/conidia observed under a compound microscope. Petriplates with moisten blotting papers and seeds were incubated at 20±2 ºC for 8 days with cycles of 12 hours light and 12 hours darkness. After 8 days of incubation fungi which developed on the seeds were identified. Similarly fungi growing out from the seeds on the **Potato dextros agar** medium (PDA) were examined. Frequency of the fungus and relative abundance was calculated and percentage germination of seeds was also recorded.

**Seed treatment**: Seeds were treated to test the efficacy of fungicide against the incidence of seed mycoflora, seeds were treated with different doses of fungicide namely Carbendazim. Seeds were placed in 150 ml flask with required doses of fungicide. Flasks were shaken to get the uniform distribution of fungicide on the seed surface. Untreated seeds were served as control after 8 days of incubation the percentage of seeds germination and mortality were observed and recorded.
Viability of seeds was estimated as the percentage germination of seeds was also recorded.

The frequency of the fungus was calculated by the following formula:

$$\frac{\text{No. of seeds containing a particular fungus}}{\text{Total seeds used}} \times 100$$

Relative abundance of the fungi was calculated by the formula:

$$\frac{\text{Total No. of colonies of a fungus on seed}}{\text{Total No. of colonies of all fungus}} \times 100$$

**Statistical Analysis** - Data regarding germination and frequency of occurrence of various seed-borne fungi were analysed statistically by applying SPSS 12.00 software (SPSS Inc. Chicago, IL, USA) wherever considered necessary. The data obtained were analysed statistically and significance was calculated at $p< 0.05$ and $p< 0.01$ levels of probability. Each value is mean of five replicates.

## RESULTS AND DISCUSSION

Different techniques were employed to study the mycoflora associated with seeds of wheat which can destroy the quality of the cereal grain and can cause a loss to its dietary and nutritional value including antioxidant properties. Inspection of dry seeds revealed the presence of mycelial bits and conidia and other fruiting bodies of fungi such as pycnidia, cleistothetia and sclerotia were found in some seeds which broken or deformed (Table 1).

**Table 1: Inspection of dry seed of *T. aestivum* variety WH896 (Observation based on 300 seeds)**

| S. No. | Observation | Remarks |
|---|---|---|
| **1.** | Colour of the pericarp | Golden |
| **2.** | Discolouration and blemishes | 3.5% |
| **3.** | Mycelieal bits and conidia | 4.25% |
| **4.** | Pycnidia | - |
| **5.** | Sclerotia | - |
| **6.** | Cleistothesia | - |
| **7.** | Other fructification | - |
| **8.** | Damaged seeds | 8.25% |
| **9.** | Deformed seeds | 21.25% |
| **10.** | Broken seeds | 7.25% |
| **11.** | Malformed seeds | 2.1% |
| **12.** | Inert matter | 3.25 |

  

**Table 2: Seed mycoflora of wheat - Variety WH896 on Blotter and PDA**

| Isolated Fungi | Blotter | | PDA | |
|---|---|---|---|---|
| | Frequency | Relative abundance | Frequency | Relative abundance |
| ***Alternaria alternata (Fr) Keissler*** | 30.00 | 24.60 | 29.00 | 24.30 |
| ***Aspergillus niger (Van Tieghem)*** | 16.00 | 11.67 | 10.00 | 8.40 |
| ***Alternaria clamydophor (Mauchacca)*** | 29.00 | 24.36 | 12.00 | 6.80 |
| ***Aspergillus flavus (Link)*** | 10.00 | 8.40 | 7.00 | 3.20 |
| ***Fusarium moniliforme (Shelden)*** | 5.00 | 4.20 | 2.00 | 1.80 |
| ***Mucor spp. (Fischer)*** | 2.00 | 1.68 | 0.00 | 0.00 |
| ***Rhizopus oryzae (Went &Gerlings)*** | 3.00 | 1.45 | 0.10 | 0.62 |
| ***Drechslera australiensis (Bugnicourt) Subram& Jain*** | 9.60 | 3.98 | 0.30 | 1.48 |
| ***Rhizopus spp. (Fischer)*** | 0.10 | 0.87 | 0.00 | 0.00 |
| ***Penicillium spp. (Link)*** | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Curvularia lunata (Wakker) Boedijn*** | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Cladosporium (Berk & Curt)*** | 0.00 | 0.00 | 0.00 | 0.00 |
| **CD at *P*< 0.05** | 1.24 | 0.99 | 0.85 | 0.70 |
| **CD at *P*<0.01** | 1.68 | 1.35 | 1.16 | 0.95 |
| **Percent germination** | | 46% | | 48% |

(-) Absence of fungus, Each value is an average of five replicates.

**Table -3 : Effect of different doses of fungicide (Carbendazim) on seed mycoflora - Wheat variety WH896**

| Isolated fungi | Control | | | | 0.5g/kg dose | | | | 1g/kg dose | | | | 1.5g/kg dose | | | | 2g/kg dose | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Blotter | | PDA | | Blotter | | PDA | | Blotter | | PDA | | Blotter | | PDA | | Blotter | | PDA | |
| | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance | Frequency | Relative abundance |
| ***A.alternata*** | 56.00 | 28.50 | 34.00 | 21.77 | 20.6 | 32.2 | 16.1 | 28.3 | 17.6 | 29.7 | 11.4 | 18.4 | 13.3 | 24.7 | 10.36 | 21.7 | 14.2 | 29.1 | 11.3 | 24.7 |
| ***A. clamydophor*** | 22.60 | 15.70 | 17.00 | 8.45 | 14.1 | 26.5 | 10.3 | 18.3 | 18.2 | 32.9 | 14.3 | 29.1 | – | – | – | – | – | – | – | – |
| ***A. niger*** | 42.60 | 21.90 | 25.00 | 15.52 | 7.2 | 17.1 | 5.6 | 10.1 | 13.7 | 23.9 | 6.1 | 12.1 | 9.3 | 19.58 | 7.3 | 15.9 | 10.3 | 20.4 | 6.4 | 12.3 |
| ***A. flavus*** | 20.00 | 14.59 | 12.00 | 5.87 | 13.6 | 25.1 | 10.3 | 21.3 | 12.3 | 22.1 | 8.3 | 16.1 | 8.3 | 16.4 | 6.6 | 15.2 | 8.8 | 16.6 | 5.0 | 11.2 |
| ***R. oryzae*** | 8.60 | 4.90 | 6.00 | 2.98 | 12.8 | 23.1 | 7.1 | 16.3 | 9.1 | 19.0 | 7.4 | 15.6 | – | – | – | – | – | – | – | – |
| ***Rhizopus spp.*** | 6.30 | 3.40 | – | – | – | – | – | - | – | – | – | – | 12.6 | 21.4 | 10.1 | 18.0 | 13.4 | 25.6 | 11.1 | 21.7 |
| ***Mucor spp.*** | 10.60 | 6.60 | 2.00 | 1.24 | 8.3 | 16.9 | 5.2 | 11.1 | 5.2 | 10.1 | 3.4 | 10.4 | – | – | – | – | – | – | – | – |
| ***F. moniliforme*** | 16.00 | 11.60 | 8.00 | 6.72 | 13.6 | 24.2 | 8.8 | 15.3 | 10.36 | 20.7 | 8.1 | 14.3 | 9.0 | 18.5 | 8.1 | 17.3 | 11.3 | 22.1 | 9.4 | 19.3 |
| ***D. australiensis*** | 8.00 | 6.72 | 1.00 | 0.60 | 11.6 | 22.6 | 6.2 | 13.1 | 9.6 | 19.1 | 6.2 | 12.1 | 6.0 | 13.5 | 5.0 | 10.6 | 8.6 | 17.1 | 6.1 | 12.4 |
| ***Penicillium spp.*** | 3.00 | 1.45 | 3.00 | 1.45 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| ***C. lunata*** | 2.00 | 1.60 | - | - | 3.3 | 8.2 | 1.4 | 0.69 | – | – | – | – | – | – | – | – | – | – | – | – |
| ***Cladosporium spp.*** | 0.33 | 0.49 | - | - | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| **Germination %** | 37% | | 42% | | 34% | | 44% | | 36% | | 48% | | 68% | | 74% | | 57% | | 68% | |

(-) Absence of fungus, Each value is an average of five replicates.

It is evident from the table 2 that 12 fungi were recorded from the seed samples which can cause damage to the quality of seeds, which secrete mycotoxins and which can interfere with the good qualities of the grain and devalue the grain.

  

Pre-treatment of seeds were done by different doses of fungicide which resulted in the enhancement of the germination percentage of seeds and can inhibit the development of the colonies of these fungal members. On the basis of the results obtained effect of fungicide was significant against the seed-borne fungi. Different doses viz., 0.5 g/kg, 1 g/kg, 1.5 g/kg and 2.0 g/kg of Carbendazim significantly reduced the incidence of frequently fungi like *Alternaria alternata* and *Aspergillus niger*, A.*clamydophor*, *Rhizopus spp*., *Mucor spp*., *Penicillium spp*., *C.lunata* and *Cladosporium*, as compared to control. The optimum dose was found to be 1.5g/kg to reduce the incidence of seed-borne fungi of wheat (Table 3). By the information of the above results it is clear that seed health testing and pre-treatment of seeds is a good measure to enhance the productivity of this antioxidant rich food.

Intensive agricultural developments are taking place in India with a view to accelerate the food production for feeding the ever increasing population and farmers are being advised to take up scientific methods and cultivars and strains of high quality plants. Wheat is the world's most important cereal being the chief source of staple food for about 1/3$^{rd}$ of the global population. Quality characters of wheat seeds such as seed germination, moisture content and nutrient value of wheat has been known to be influenced by various factors which interfere with the normal development and behaviour of plants. Seed-borne pathogens of wheat are responsible for causing variations in plant morphology and also reducing the yield from 15-90% if infected seeds are planted in the field (Wiese,1984). Each year about 20% of the wheat that otherwise would be available for food and feed as lost due to diseases (Fakir,1999). Seed mycoflora of wheat reported by different workers include *Alternaria alternata*, *Drechslera sorokiniana*, *Fusarium moniliforme, F.avenaceum, F.graminearum, F.nivali, F.equiseti*, *Cladosporium herbarum*( Nirenberg et.al. 1994, Glazek 1999, Mirza and Qureshi 1978). Knowing the importance of wheat it is quiet necessary to study the disease causing agents of this important plant and to study the different methods to protect the crop. According to the biochemist Dolores Takemoto that they are modifying the wheat plant to produce more of its own cancer fighting chemicals, strains of wheat that have higher quality grains and that have enhanced amounts of these antioxidants in them. As we all know that antioxidants are important because they are able to fight the body's free radicals, charged particles produced by the body which can cause damage to us and we want to keep them from forming because they contribute to heart diseases, cancer, diabetes, cataracts and even wrinkling.

Whole grains including wheat contain several compounds that are capable of minimizing the damaging effects of oxidation reactions. These include phytate, proteins, polysaccharides, phenolics, lignins and tocopherols (Aleen and Changrun Lu ,2000). Synthesis of antioxidants in wheat sprouts was worked out by Isabella et.al (2004). In wheat antioxidants are found in the plants- orthophenols; and there are many strains of wheat which are rich in orthophenols. Thus it is the need of the hour to protect this antioxidant rich plant because eating whole grain products and including whole grain wheat into your regular diet will have greater effects than using vitamin pills to compensate for a poor diet.

**REFERENCES**

**Akhtar L. H. and Siddiqui S.Z. (2003).** Current status of research and development on pulses in Pakistan. *Sci. Tech. Development.* 22(1): 16-28.

**Aleen J. and Changrun Lu (2000).** Potential of wheat based breakfast cereals. *J. Am. College Nutrition.* 19: 308S-311S.

**Annonymous (1996).** International seed testing association. International rules for seed testing. *Proc. Int. Seed Test Assoc. 31:752.*

**Fakir G.A. (1999).** Seed health an indispensable agro-technology for crop production. Lecture note for course on agro-technology and environment management for the CAPITAS officers at GTI, BAU, Mymensingh from 21-30:1-4.

**Glazek M. (1999).** Mycoflora of winter wheat seeds harvested from flooded commercial fields in south-western Poland in 1997. Plant Protection Institute in Poznaniu, Sosnicowice Branch, Gliwicka St. 29: 44-153, Sosnicowice, Poland.

**Isabella C. et al., (2004).** Synthesis of antioxidants in wheat sprouts. *J. Agric. Chem*. 52(16):5201-5206.

**Mirza J. H. and Qureshi M.S.A. (1978).** Fungi of Pakistan, University of Agric., Faisalabad, Pakistan, pp 311.

**Nirenberg H., Schmitz Elsherif H. and Ckling C.I. (1994).** Occurence of *Fusaria* and some "blackening moulds" on durum wheat in Germany. I. Incidebce of *Fusarium* species. Pflanzenkrankheiten Pflanzenschuntz. 101: 449-459.

**Subramanian M. (2000).** Pulses production strategies in Tamil Nadu Agricultural University Coimbatore (India).

**Wiese M.V. (1984).** Compendium of wheat diseases.3$^{rd}$Ed.The Am. *Phytopath*. Soc.106.

  