International Journal of Pharma and Bio Sciences

AN EVALUATION ON THE VIABILITY ON THE POST-HARVESTED STORED WHEAT GRAINS

DR. SHIJU MATHEW

Assistant Professor, Department of Molecular Biology & Genetic Engineering,
Allahabad Agricultural Institute – Deemed University, Allahabad 211007 (India)

Correspondence Author shijumathew_biotech@yahoo.com.

ABSTRACT

The seed viability of stored wheat grains was checked by sprouting test. The germination studies shown that viability of the stored wheat grain reduces on storage. The study has shown that the U.P. 262 has much more sprouting capability as compared to H.D. 1982. The sprouting capacity of both the varieties analyzed showed a decrease to about 70% after three years of storage. After 3 years it takes from days to weeks and in some cases even months for sprouting to be complete. The seed viability approaches was utilized to understand the wheat grain quality under post harvest storage. Thus concrete steps should be taken to improve the storage conditions in the government godowns which is the single largest granary of India. It was observed that a holistic ecological view is needed when considering management approaches to long-term-storage of wheat grains for the maintenance of quality. Methodologies should be examined to develop a new and better method for preservation of stored wheat grains with minimal loss of nutrient content. The germination capacity of the stored wheat grain reduces with time. The research paper helps to determine the sprouting capacity of stored wheat grains for agricultural purposes. The grain losses found in quantity and quality; can be in the form of depletion in seed viability, hardness, colour, size and shape, grain weight under post harvest storages.

KEY WORDS

wheat grain, post-harvest, storage, viability, germination, quality and quantity loss.

INTRODUCTION

Wheat (the *Triticum* spp.) is cultivated worldwide. Globally, wheat is the most-produced food among the cereal crops after rice. Wheat grain is a staple food used to make flour for leavened, flat and steamed breads; cookies, cakes, breakfast cereal, pasta, noodles; and for fermentation to make beer, alcohol, vodka or even biofuel. Among the various seeds of cereals, the wheat grains provide more food to over one thousand million human beings of this earth than any other plant or animal products. According to an estimate (U.S. Year Book of Agriculture, 1961), about one fourth supply of human energy comes from the wheat grains in the United States; It is therefore, most appropriate that these wheat grain must be protected at all stages of handling, from the time of harvest, through storage, transportation and processing, upto the time they are ready to

be consumed. The post harvest loss of wheat grain has been found to be highest during storage (Magan *et al.,* 2003). Stored grains can have losses in both quantity and quality. Losses occur when the grain is attacked by microorganisms and other organisms including insects, mites, rodents and birds (Neetirajan *et al*., 2007).

There are a number of evidences that indicate invasion of wheat grains by storage microorganism can drastically reduce their germinability (Papavizas and Chritensen, 1960). The grain contains various nutritive substances, causing other organisms to grow very efficiently and reduce the viability of stored seeds (Karppanen *et al.,* 1985; Jayas, 1995; Humpisch, 2001; Lugauskas *et al.,* 2002; Bakutis, 2004).

This has been considered as a major factor for grain quality with special reference to the seed viability. It is used in differentiating hard and soft classes of wheat. When hard grains are used for making flour, their endosperm is cracked along the line of aleurone layer giving more flour yield. On the other hand, most part of aleurone layer in soft wheat remains with endosperm, which causes inconsistency in flour during milling operation. The abiotic variables include temperature and moisture content of the grains; the latter in grains increases due to seepage of moisture from soil or from cemented floor (Pingale, 1970). Water absorption has a direct effect on the amount of bread produced and is considered to be an important quality factor (Hosoney, 1987; Wosniak and Styk, 1996; Nakatsku, 1998; Mis and Giodecki, 2000, Wosniak, 2001).

When hard grains are reduced to flour, large number of starch granules get damaged which in turn absorb more water. While in softer wheat, as the number of damaged granules of starch is low, and the water absorption is less. Various methods for measuring the grain hardness by sprouting test, particle size index, pearling resistance, grinding resistance (time to grind), sound of grinding, starch damage, near-infrared (NIR) analysis and crushing or slicing of individual kernels have been proposed (Pretson *et al.,* 1978; Luckow and Bushuk, 1984; Leelavathi *et al.,* 1990; Koekskel *et al.,* 1993; Gaines*,* 2000; Mis *et al.,* 2000; Singh *et al.,* 2001; Famera *et al.,* 2004). A positive correlation has been established between the permissible moisture content of grain, α-amylase activity, the hardness and viability of stored grains (Mis and Grundas, 2002; Mohammadkhani, 2005).

MATERIALS AND METHODS

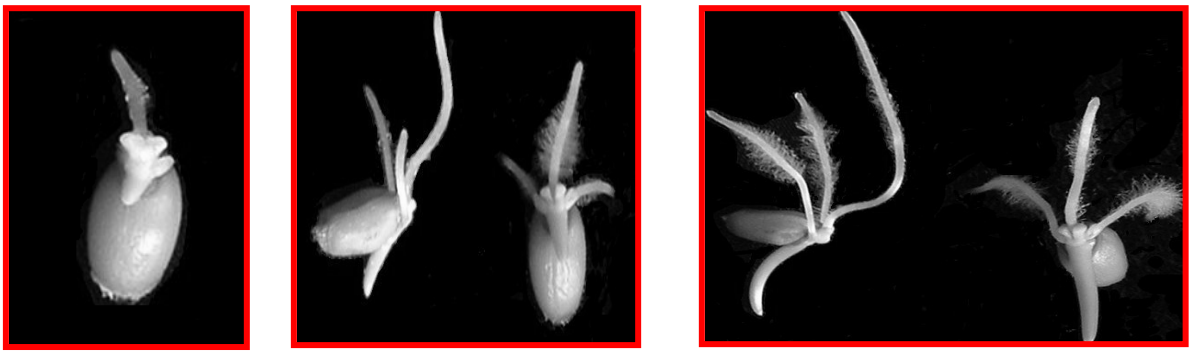
The investigation was done at Allahabad Agricultural Institute-Demmed University, Allahabad in India. . The work was an attempt to correlate the seed viability and quality of wheat grain under storage. The wheat samples were collected separately in 3 replicates for each of the wheat (*Triticium aestivum* L.) varieties viz., U.P. 262 and H.D. 1982 from government godown, Naini, Allahabad district, whole sale dealers from Naini and Muttiganj markets of Allahabad and from the local farmers. The samples were brought to the laboratory under aseptic condition where they were screened (before washing and after washing with water). The wheat grain samples collected from different locations of Allahabad were subjected to sprouting test for determining the seed viability and germination. The Determination of seed viability of stored wheat grains by sprouting test protocol (Armolik *et al.,* 1956).

i) The wheat grains were surface sterilized with 0.2% sodium hypochlorite for one minute.
ii) The surface sterilized seeds were washed thoroughly with sterile water for 5 times.
iii) The seeds were placed in petridishes with two layers of Whatmann No.1 filter paper.
iv) The seeds were placed with the crease facing down in the petridishes containing 15 ml of distilled water.
v) The petridishes were covered and incubated in a germination cabinet at 22^0C and approximately 95% relative humidity with light for 72 hours.

vi) The grains in which plumule developed into a shoot were considered to have sprouted and the observations on germination were recorded.

RESULTS AND DISCUSSION

Germination test is the best indication of seed viability. The depiction of a germinating wheat grain is given in Figure 1.1. The maximum and minimum percentage of sprouting in the stored wheat grains for UP 262 and H.D.1982 were 95 to 62% and 96 to 70% respectively. A gradual reduction in germination percentage/seed viability was observed for all the four periods under study. The germination percentage observed in H.D.1982 was slightly more than U.P. 262. Compared to all other collection sites, the wheat grain samples collected from government godown, Naini (S1) showed a slight increment in the germination percentage except for the P4 samples in H.D.1982 where S2 showed an increased germination percentage (Figure 1.2 and Figure 1.3).



(i) (ii) (iii)

Figure 1.1: ***Viability of the wheat grain seeds by sprouting test with different time duration. (i) Germination after 24 hours (ii) Germination after 48 hours (iii) Germination after 96 hours***

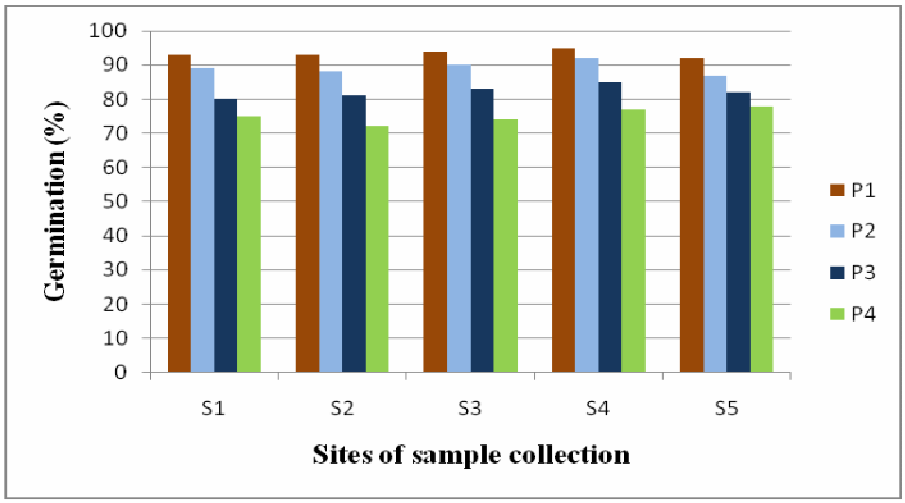


Figure 1.2
Germination of wheat grain samples (U.P. 262) by sprouting test

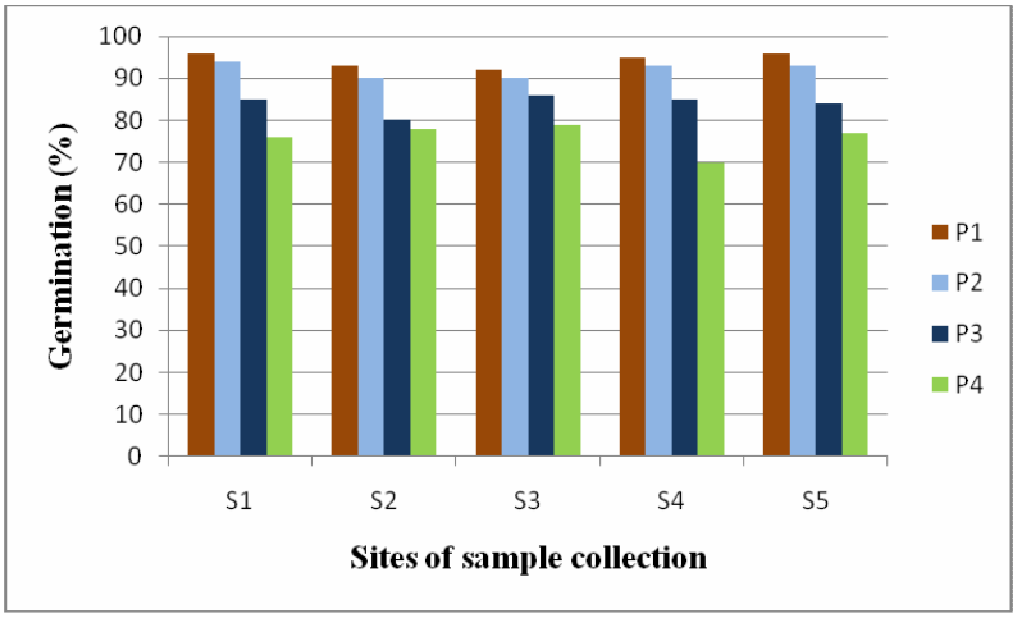


Figure 1.3
Germination of wheat grain samples (H.D.1982) by sprouting test

***Stastical Analysis*:** The statistical analysis of wheat grain viability is calculated from the value of F due to period and due to variety is greater than their respective F values at 5% probability level. Whereas the calculated F value due to site is smaller at 5% probability level than its table value and hence there is no significant difference due to site on grain viability, concluding that there is significant effect of period on the wheat grain viability and there is a similar significant difference between the two varieties on the stored grain viability.

The genetic variation in dormancy is expressed as a distribution of germinability over time. The result obtained in the investigation showed that the stored grain loses its viability with time. This can possibly be due to the mycotoxins produced by fungi. Similar results of post harvested wheat grains having reduced sprouting under storage has been obtained by other scientists (Christensen and Drescher, 1954; Hummel *et al.,* 1954; Christensen, 1955, 1964; Armolik *et al.,*1956; Tuite and Christensen, 1957; Qasem and Christensen, 1958; Papavizas and Christensen, 1960; Field and King, 1962; Christensen and Lopez, 1963; Schoental and White, 1965; Leelavathy, 1966; Sullia, 1966; Lopez and Christensen, 1967; McCalla and Norstadt, 1967; Das and Srivastava, 1969; Misra and Singh, 1969, Lalitha *et al.,*1970; Ayachi, 1971; Roy *et al.,*1972; Srivastava, 1974; Chandra *et al.,*1985). The results show that, as storage period increases the sprouting decreases i.e., storage increases dormancy. However, this may vary depending on genotype. Reddy *et al.* (1985) reported that the maximum potential seed dormancy of a genotype can be determined by evaluating the seeds in a range of germination temperatures. In Mares study of two genotypes from five different sites, the sprouting differences were greater among the collection sites of stored grain samples. It might be expected that if the germination tests were carried out over a longer period, and under the storage conditions the required nutrients are affected which would protract dormancy with time. However, there is good reason to achieve seed germination as quickly as possible to avoid protracted germination. Protracted germination uses expensive growth facilities, may delay results, and place tests at a higher risk of

contamination with microbial growth. Similar results are available in literature (DePauw and McCaig 1989 and Mares 1992).

During the course of this work, sprouting process and its effects on the quality of wheat grain was studied. They are composed of two separate stages: soaking of grains, and germination (incubation) of grains (Preston *et al.,* 1978; Lukow and Bushuk, 1984; Leelavathi *et al.,* 1990; Singh *et al.,* 2001).

ACKNOWLEDGEMENT

I gratefully acknowledge the cooperation, uninterrupted guidance, impeccable and valuable suggestions rendered to me by Prof. (Dr.) George Thomas during my research work.

REFERENCES

1. Armolik, N., Dickson, J.G. and Dickson, A.D. (1956). Deterioration of Barley in storage by microorganisms. *Phytopathol.* 46: 457-461.
2. Ayachi, S.S. (1971). Mycoflora of wheat grain–IV: Toxin production of some frequently occurring fungi. Nat. Acad. Sci. Annual number (Abstract) pp 91.
3. Bakutis B. (2004). Microrganism grown on seeds. Kaunas: Terra Publication. pp. 81.
4. Chandra, S., Narang, M. and Srivastava, R.K. (1985). Studies on mycoflora of oilseeds in India. Interrelationship between mycoflora and seed. *J. Seed Sci. and Technol*. 13: 543-549
5. Christensen, C.M. (1955). Grain storage studies 21: Viability and Moldiness of Commercial wheat in relation to the incidence of germ damage. *Cereal Chem.* 32: 507-518.
6. Christensen, C.M. (1964). Effect of moisture content and length of storage period upon germination percentage of corn, wheat and barley free of storage fungi. *Phytopathol.* 54: 1464-1466.
7. Christensen, C.M. and Drescher, R.F. (1954). Grain storage studies.XIV. Change in moisture content,germination percentage and moldiness of wheat samples stored in different portions of bulk wheat in commercial bins. *Cereal Chem.* 31: 206-216
8. Christensen, C.M. and Lopez, F. (1963). Pathology of stored seeds. *Proc. Int. Seed Testing Assoc.* 28: 701-711.
9. Das, A.M. and Srivastava, D.N. (1969). Production and action of wheat seedling of toxic metabolites of *Helminthosporium sativum Ann. Phytopathol. Soc. Japan* 35: 275-285.
10. DePauw, R.M. and McCaig (1989). Interrelationsships among assays for germination of kernels from treshed spikes, untreshed spikes and alpha-amylase in wheat. In: Fifth Int. Symp. Pre-Harvest Sprouting Cereals. (K. Ringlund, E. Mosleth and D. Mares, eds.). Westview Press Inc, Boulder, Co. pp. 84.
11. Famera, O., Hruskova, M. and Novotna, D. (2004). Evaluation of methods for wheat grain hardness determination. *Plant Soil Environ.* 11: 489-493
12. Field, R.W. and King, T.H. (1962). Influence of storage fungi on the deterioration of corn in storage a review. *Lowa Acad. Sci.* 51: 265-280.
13. Gaines C.S. (2000). Associations of starch gel hardness, granule size, waxy allelic expression, thermal pasting, milling quality, and kernel texture of 12 soft wheat cultivars. *Cereal Chem*. 77 : 163-168.
14. Hoseney, R.C. (1987). Wheat hardness. *Cereal Fd. World* 32: 320-322.
15. Hummel, B.C.W., Caundet, L.S., Christensen. C.M. and Geddes, W.F. (1954). Grain storage studies. 13: and comparative changes in respiration, viability and mold contaminated wheat upon storage. *Cereal Chem.* 31: 143-150.

16. Humpisch, G. (2001). Gesundheitsvorsorge im Getreidelager. *Neue Landwirtschaft*. Vol. 2. pp. 44-48.
17. Jayas, D. S. (1995). *Stored-grain ecosystems*. New York: Dekker, pp. 757.
18. Karppanen, E., Rizzo, A., Berg, S., Lindfors, E. and Aho R. (1985). Fusarium mycotoxins as a problem in Finnish feeds and cereals. *J. Agricul. Sci. Finland* 57: 195-206.
19. Koeksel, H., Atli, A., Oezkaya, H. and Demir, Z. (1993). Comparison of physical properties of wheat and NIR spectroscopy hardness value for prediction of semolina yield. *J. Agr. Forest*. 17: 821-830.
20. Lalithakumari, D., Govindaswamy, C.V. and Vidyasekeran, P. (1970). Role of Aflatoxins in groundnut seed spoilage. *Curr. Sci.* 39: 308-309.
21. Leelavathi, K., Vetrimani, R. and Haridas-Rao, P. (1990). Changes in the functional characteristics of wheat during soaking and subsequent germination. *J. Fd. Sci. Technol.* 27: 349-354.
22. Leelavathy, K.M. (1966). Studies on some aspect of the rhizosphere mycoflora of the important fooder grasses of Uttar Pradesh, Ph.D. Thesis Banaras Hindu University, India.
23. Lopez, L.C. and Christensen, C.M. (1967). Effect of moisture content and temperature on invasion of stored corn by *Aspergillus flavus. Phytopathol.* 57: 588-590.
24. Lugauskas, A., Paskevicius, A. and Repeckienė, J. (2002). Pathological microorganism application Vilnius pp. 434.
25. Lukow O. M. and Bushuk, W. (1984). Influence of germination on wheat quality. I. Functional (bread making) and biochemical properties. *Cereal Chem*. 61: 336-339.
26. Magan, N., Hope, R., Cairns, V. and Aldred, D. (2003). Post-harvest fungal ecology: impact of fungal growth and mycotoxin accumulation in stored grain. European *J. Plant Pathol.* 109: 723-730.
27. Mares, D. J. and Ottler, G. (1992). *α*-Amylase activity in developing triticale grains. *J. Cereal Sci.* 13: 151-160.
28. McCalla, T.M. and Norstadt, F.A. (1967). Influence of patulin on the growth of wheat plants. *Bact. Proc*. pp 17.
29. Mis, A. and Geodecki, M. (2000). Changes in wheat grain hardness during ripening and harvest (in Polish). *Acta Agrophysics*, 37: 119-129.
30. Mis, A. and Grundas, S. (2002). Wheat grain hardness and quality. *Int. Agrophysics* 16: 283-288.
31. Mis, A., Grundas, S. and Geodecki, M. (2000). Changes in hardness and thickness of wheat grain as a result of its moistening. *Int. Agrophysics* 14: 203-206.
32. Misra, A.P. and Singh, T.B. (1969)..Inhibitory effects of the culture filterates from *Helminthosporium nodulosum* and *H. leucosylum* to seeds and seedlingsof *Eleusine coracana. J. Appl. Sci. India* 1: 19-21.
33. Mohammadkhani, A. (2005). Study of Pentosans (Non Starch Polysaccharides), in Durum Wheat and its Relation to the Quality of Protein and Grain Hardness Index (H.I.). *Pak. J. Nutri.* 4: 208-209.
34. Nakatsu, S. (1998). Effects of wetting treatment period and moisture content on water uptake by wheat grain during germination and alpha-amylase activity. Japanese *J. Crop Sci.* 67: 165-169.
35. Neethirajan, S., Karunakaran, S., Jayas, D.S. and White, N.D.G. (2007). Detection techniques for stored-product insects in grain. *Int. Fd. Control* 18: 157-162.
36. Papavizas, G.C. and Chritensen, C.M. (1960). Grain storage studies 29: Effect of invasion by individual species and mixture of *Aspergillus* upon germination and development of discoloured germs in wheat, *Cereal Chem.* 27: 197-230.
37. Pingale, S.V. (1970). Prevention and losses in storage. *Bull. Grain Technol.* 8: 3-13.
38. Preston K.R., Dexter J.E. and Kruger J.E. (1978). Relationship of exoproteolytic and endoproteolytic activity to storage protein hydrolysis in germinating durum and hard red spring wheat. *Cereal Chem.* 55: 877-888.

39. Qasem, S.A. and Christensen, C.M. (1958). Influence of moisture content, temperature and time on the deterioration of stored corn by fungi. *Phytopathol.* 48: 544-549.
40. Reddy, L.V., Metzger, R.J. and Ching, T.M. (1985). Effect of temperature on seed dormancy of wheat. *J. Crop Sci*. 25: 455-458.
41. Roy, R.Y., Dwivedi, R.S. and Gupta, V.K. (1972). Effect of rhizosphere mycflora on the growth of *Trigonella foenum-graecum* Linn. *Proc. Nat. Acad. Sci. India* 42: 105-110.
42. Schoental, R. and White, A.F. (1965). Aflatoxins and albinism in plant. *Nature,* 206: 57-58.
43. Singh, H. Singh, N. Kaur, L., and Saxena, S.K. (2001). Effect of sprouting conditions on functional and dynamic rheological properties of wheat. *J. Fd. Eng.* 47: 23-29.
44. Srivastava, A.K. (1974). Some studies on mycoflora, specially fungi, associated with barley and millet in storage (Abstract). Proceedings of International storaging seeds pp.34.
45. Sullia, S.B. (1966). Age as factor in the rhizosphere mycflora of wild leguminous plant. Ph.D. Thesis. Banaras Hindu University, India.
46. Tuite, J.F. and Christensen, C.M. (1957). Grain storage studies 24: Moisture content of wheat seed in relation to invasion of seed by species of the *Aspergillus glaucus* group and the effect of invasion upon germination of the seed. *J. Phytopathol.* 47: 323-327.
47. U.S. Department of Agriculture (1961). Yearbook of Agriculture, Washington D.C. pp. 148.
48. Wosniak, W. (2001). Effect of moisture treatment of wheat grains on technological hardness (in Polish). *Acta Agrophysics* 46: 227-233.
49. Wosniak, W. and Styk, W. (1996). Internal damage to wheat grain as a result of wetting and drying. *J. Drying Technol.* 14: 349-365.