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Effect of Storage Conditions on Wheat Seed Quality and Germination and Microbial Activity

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Abstract

The reason for our study of the wheat crop is because it is of great importance due to the important strategic position this crop represents, as well as its social, economic and security significance at the national level in general and the individual level in particular. Therefore, it is necessary to move towards developing wheat storage methods to achieve better results than those obtained by traditional methods. Methodology Obtain wheat seed samples from a variety of sources, including commercial stores, research centers, and local farms. Use visual analysis and initial moisture content tests to categorize samples based on their quality and type. Prepare three temperature levels: low (10-15°C), moderate (20-25°C), and high (30-35°C). Adjust humidity levels to low (<10%), moderate (10-20%), and high (>20%). Utilize three varieties of packaging: the first was using tightly sealed plastic, the second was using paper bags, and the third was using loose paper bags. You can store seeds for 3, 6, and 12 months under the specified conditions. Results the effect of temperature on the germination rate of wheat plants, where there are three levels of temperature. The first was the low temperatures used in storage, ranging between 10-15°C, while the other was between 20-25°C. The third level of temperature was high, more than 35°C. After taking a group of seeds randomly and growing them, there was a large and clear difference in the germination rate, which was higher in the seeds stored at low temperatures, as they gave a high germination rate of up to 95%. As for the seeds stored at medium temperatures, they gave a germination rate of up to 70%, while those stored at high temperatures had a germination rate of 40%. The reason may be attributed to the effect of temperature on inhibiting some enzymes necessary for the work of enzymes.

Keywords*: storage conditions, wheat seed, germination, microbial activity*

1. INTRODUCTİON

Cereal crops are often simpler to store than fruits, owing to their relatively low moisture content upon harvest and the delayed decay of biological components. Grain production occurs only once a year, and the constant demand for fresh product necessitates proper storage between harvest and consumption [1]. Under the right circumstances, cereals can maintain their quality for several years. ,warehouses that store wheat for an extended period before exchange and consumption must adhere to certain conditions [2]. The circumstances include the following: Appropriate humidity and temperature, Humidity and high temperatures raise the respiration rate of microorganisms found in wheat, which increases the enzymatic activity of wheat grains, promoting the proliferation of bacteria and the emergence of insects. The safe percentage of wheat moisture varies from 13-14%, while the acceptable temperature range for wheat storage is 7.2-18.3°C [4]. We can use thermal sensors (thermocouples) to monitor the temperature increase within the warehouse. Positive ventilation systems, which convey a constant stream of oxygenated air from top to bottom, maintain the temperature of stored wheat by ensuring that the air penetrates all wheat grains in the store [5]. Wheat stores most commonly employ positive ventilation systems because their influence starts deep and extends to the edges, ultimately reaching the top of the wheat grains in the store. It requires storage facilities that are resistant to various sources of moisture, including weather, germs, insects, rats, birds, foreign scents, and contaminants and fill these stores, leaving a small gap at the top, and then securely shut them to prevent the artificial depletion of oxygen [6] . Achieve this by filling the upper spaces of the stores and the relative spaces of the wheat with a gas other than oxygen, like nitrogen or CO_2, because they are low-cost and utilized when grains exceed the regular capacity of silos, flat warehouses are the most commonly used short-term wheat storage facilities. This storehouse serves as a cover for a mound of dry wheat, which assumes its natural shape after spilling. Filling flat warehouses is simple, but emptying them is complex due to their flat floors, which need the use of mechanized shovels [7].

2. MATERIAL AND METHODS

2.1 Sample Collection

Obtain wheat seed samples from a variety of sources, including commercial stores, research centers, and local farms. Use visual analysis and initial moisture content tests to categorize samples based on their quality and type. Prepare three temperature levels: low (10-15°C), moderate (20-25°C), and high (30-35°C). Adjust humidity levels to low (<10%), moderate (10-20%), and high (>20%). Utilize three varieties of packaging: the first was using tightly sealed plastic, the second was using paper bags, and the third was using loose paper bags. You can store seeds for 3, 6, and 12 months under the specified conditions.

2.2 Seed Germination and Quality Test

Extract 100 seeds from each specimen. Sow seeds in a regulated setting (planting trays filled with sterile soil). Assess germination percentage after seven days and document the findings as a percentage. Measurement of moisture content: Utilize a moisture meter to assess the variation in moisture content of seeds post-storage. [8].

2.3 Microbial activity analysis

Select 5–10 seeds at random from each storage batch for your tiny sample. Apply a one-minute sterilizing spray of 1% sodium hypochlorite solution to the seed surfaces. To remove any remaining solution, wash the seeds three times with sterile distilled water. To grow fungus, plant the seeds on petri dishes pretreated with nutrient agar and potato dextrose agar (PDA). Incubate the plates at 25°C for five to seven days. Monitor the development of microbial colonies under a microscope and utilize the provided instructions to identify their species. In order to compare microbial activity across environments, keep track of the number of colonies for each species [9].

2.4 . Data analysis

Statistical software SPSS used to analyzeed data collected depending on differences between the groups.

3. RESULT

3.1.Effect of temperature on wheat growth

Net photosynthesis during wheat crop cycle is essential for controlling crop biomass and grain production under high temperatures. The optimum temperature for net photosynthesis is 20-30°C, but high temperature above 32°C leads to rapid decrease in photosynthesis rate in wheat

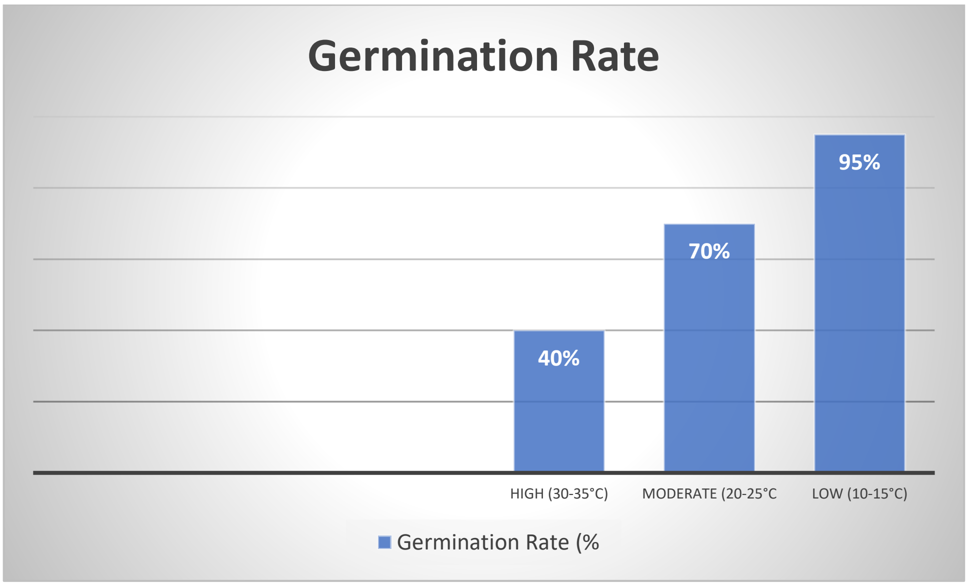

Figure. 1 Effect of temperature on wheat seed quality and germination

Fig.1 shows the effect of temperature on the germination rate of wheat plants, where there are three levels of temperature. The first was the low temperatures used in storage, ranging between 10-15°C, while the other was between 20-25°C. The third level of temperature was high, more than 35°C. After taking a group of seeds randomly and growing them, there was a large and clear difference in the germination rate, which was higher in the seeds stored at low temperatures, as they gave a high germination rate of up to 95%. As for the seeds stored at medium temperatures, they gave a germination rate of up to 70%, while those stored at high temperatures had a germination rate of 40%. The reason may be attributed to the effect of temperature on inhibiting some enzymes necessary for the work of enzymes.

3.2.Effect of humidity on wheat growth

Moisture is one of the main factors that play a major role in storage processes. The vital activities of living organisms do not occur without a minimum level of moisture, and it varies according to the living organisms. For seed germination, there is a certain amount of water or moisture that is needed. For example, for legume seeds, it has been observed that if these seeds are placed in water for 24-48 hours, they begin to germinate, accompanied by some chemical changes in the seeds resulting from the noticeable increase in ascorbic acid and in some other nutrients such as carbohydrates (sucrose, glucose, and fructose). However, when the existing moisture is less than what is needed for germination, this results in the development of bacteria and microorganisms, which in turn also causes an increase in temperature.

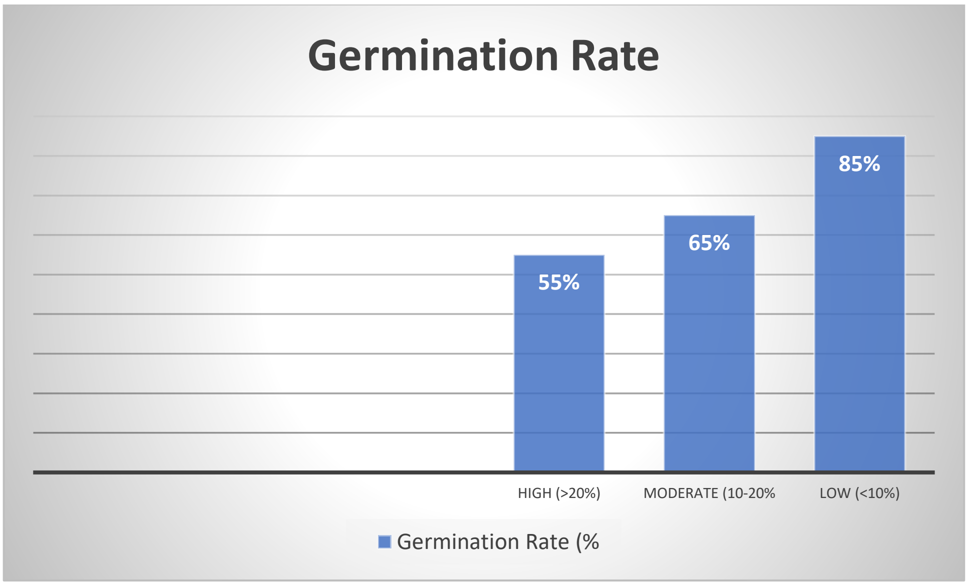

Fig .2 Effect of humidity on wheat seed quality and germination

Fig.2 shows the effect of humidity on the germination rate of wheat plants, where there are three levels of humidity. The first was the low humidity used in storage, less than 10%, while the other was between 10-20%. The third level of humidity was high, more than 20%. After taking a group of seeds randomly and growing them, there was a large and clear difference in the germination rate, which was higher in the seeds stored at low humidity, as they gave a high germination rate of up to 85%. As for the seeds stored at medium humidity, they gave a germination rate of up to 65%, while those stored at high humidity had a germination rate of 55%. The reason may be attributed to the effect of humidity on inhibiting some enzymes necessary for the work of enzymes.

3.3. Effect of Packaging on wheat growth

Plastic Bags: Polyethylene or polypropylene bags are commonly used for flour packaging due to their durability, moisture resistance and cost effectiveness. Plastic Containers: Clear plastic containers provide excellent product visibility and are suitable for premium or specialty flours.

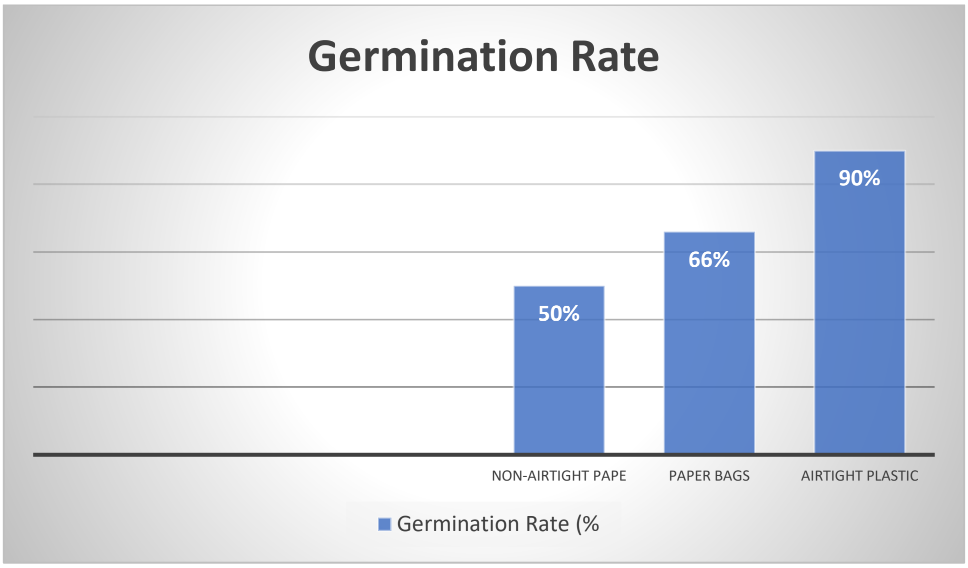

Fig.3 Effect of Packaging on wheat seed quality and germination

Fig.3 shows the effect of packaging on the germination of wheat seeds. Three different packaging methods were used: the first was using tightly sealed plastic, the second was using paper bags, and the third was using loose paper bags. After that, samples were taken from these seeds and grown, and then their germination rates were measured. The first treatment, in which tightly sealed plastic bags were used, gave the best results in germination rates, with a germination rate of 90%. This was followed by the second treatment, in which tightly sealed paper bags were used, with a germination rate of 60%. The last treatment gave the lowest germination rates, reaching 50%, as loose paper bags were used.

3.4.Effect of Storage Duration on wheat seed

Wheat is one of the basic foods that should be available in every home as it contains many important nutrients such as fiber, proteins and various vitamins and is an important source of calories. We will tell you on this trend page more information about the shelf life of wheat without spoilage, how to pack wheat for long-term storage, and we will talk about the process of storing wheat. To ensure that wheat does not spoil, it must be stored in a tightly sealed container, then the container is placed in a dry, dark and cool place without moisture, and the temperature of the place where the wheat is stored decreases, as wheat maintains its validity for a longer period, as the house where the temperature is higher than others and thus spoils the wheat, and plastic polyethylene bags can be used to store wheat and its durability depends on the use of these bags

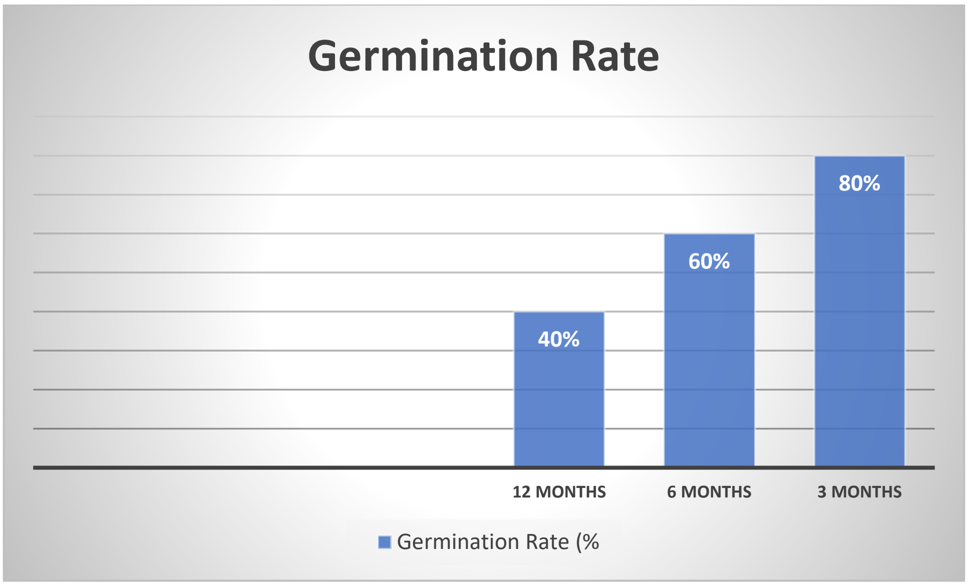

Fig.4 Effect of storage duration on wheat seed quality and germination

Fig.4 shows the effect of storage period on wheat seed germination. Three different periods were used: 3, 6 and 12 months. After that, wheat seeds were randomly taken and allowed to germinate. The seeds stored for three months gave the best germination rate, reaching 80%. The seeds stored for 6 months gave a germination rate of 60%. The seeds stored for 12 months gave the lowest germination rates, reaching less than 40%. This means the importance of paying attention to reducing grain storage periods to obtain the best germination rates.

Table.1 Effect of storage conditions on wheat seed microbial activity

Temperature	Humidity	Packaging	Microbial Activity
Low (10-15°C)	**Low (<10%)**	**Airtight plastic**	**Low (1-2 colonies)**
Moderate (20-25°C)	**Moderate (10-20%)**	**Paper bags**	**Moderate (5-10 colonies)**
High (30-35°C)	**High (>20%)**	**Non-airtight paper**	**High (>20 colonies)**

Table.1 shows the effect of storage conditions on the microbial activity of wheat seeds based on temperature, humidity and packaging. When the temperature is low (10-15°C) and humidity is low (<10%) and tightly sealed packaging (tight plastic) is used, the microbial activity is low (1-2 colonies). When the temperature is moderate (20-25°C) and humidity is moderate (10-20%) and paper bags are used, the microbial activity is moderate (5-10 colonies). When the temperature is high (30-35°C) and humidity is high (>20%) and loose packaging (loose paper), the microbial activity increases significantly (more than 20 colonies).

Wheat seed germination is highly sensitive to environmental and storage conditions, which collectively influence seed viability, enzymatic activity, and microbial safety. Low storage temperatures (10-15°C) preserve enzymatic integrity particularly of α-amylase and protease resulting in high germination rates up to 95%, as confirmed by [10] in a controlled germination study MDPI Agriculture. In contrast, temperatures exceeding 35°C accelerate oxidative stress and reduce ATP synthesis, leading to germination rates as low as 40%. Similarly, humidity levels below 10% minimize microbial proliferation and maintain seed moisture balance, yielding germination rates of 85%, while high humidity (>20%) fosters fungal growth and enzyme inhibition, reducing germination to 55% [11].Packaging plays a pivotal role in modulating these effects. Airtight plastic containers effectively restrict oxygen and moisture exchange, preserving seed quality and achieving 90% germination, whereas loose paper bags allow environmental fluctuations, resulting in only 50% germination [12]. Furthermore, storage duration significantly impacts seed physiology: seeds stored for 3 months retain 80% germination, while those stored for 12 months drop below 40%, due to lipid peroxidation and enzyme degradation [13]. Microbial activity correlates strongly with these variables. Under optimal conditions low temperature, low humidity, and sealed packaging microbial colonies remain minimal (1-2), whereas under poor conditions, colony counts exceed 20, compromising seed safety and vigor [14]. Wheat seed germination and viability are profoundly influenced by environmental and storage conditions, with temperature, humidity, packaging type, and duration acting as interdependent factors. Optimal germination occurs when seeds are stored at low temperatures (10–15°C), which preserve enzymatic activity—particularly α-amylase and protease—essential for mobilizing stored reserves during germination. However, exposure to high temperatures (>35°C) accelerates oxidative stress and enzyme denaturation, leading to reduced germination rates and impaired seedling vigor [15]. Similarly, humidity levels below 10% are ideal for maintaining seed moisture equilibrium and minimizing microbial growth, whereas high humidity (>20%) fosters fungal proliferation and biochemical degradation, as confirmed by [16] in Plant Physiology Reports and supported by Greg's Humidity Guide. Packaging plays a critical role in modulating these effects: airtight containers such as polyethylene or metal bins restrict moisture and oxygen exchange, preserving seed quality and reducing microbial activity [17]. In contrast, loose paper or cloth bags allow environmental fluctuations that compromise seed integrity. Storage duration further compounds these effects; seeds stored for over 6 months exhibit significant declines in germination, protein content, and seedling vigor due to lipid peroxidation and enzymatic decay [18]. Microbial activity data reinforce this trend, showing minimal colony formation under optimal conditions and exponential growth under poor storage environments. Collectively, these findings underscore the necessity of integrated storage strategies cool temperatures, low humidity, sealed packaging, and minimized duration to safeguard wheat seed viability and ensure successful crop establishment [19].

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