# Evaluation Of Biodeterioration Of Soybean And Safflower Seeds During Storage

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**Abstract**

Stored seeds of soybean (*Glycine max)* and safflower (*Carthamus tinctorius*) are highly vulnerable to biodeterioration caused by fungal contamination, which can adversely affect their nutritional quality, germination potential, and market value. This study investigates the extent of fungal biodeterioration in soybean and safflower seeds stored under different environmental conditions. Seed samples were collected from various storage facilities and analyzed for fungal contamination using standard mycological techniques. The predominant fungal species identified included *Aspergillus flavus*, *Aspergillus niger, Fusarium spp*., and *Penicillium spp*. These fungi caused significant biochemical and structural damage, including reduced seed viability, discoloration, and the production of harmful mycotoxins. Environmental factors such as high humidity and temperature were found to exacerbate fungal growth and biodeterioration. The study highlights the need for proper storage management practices, such as maintaining low moisture levels, controlling temperature, and applying antifungal treatments, to minimize fungal contamination and preserve the quality of stored seeds.

**Key Words:** *Aspergillus flavus*, *Aspergillus niger, Fusarium spp*., and *Penicillium spp*.

## Introduction

Seed storage is a critical aspect of agriculture and food security, as it ensures the availability of high-quality seeds for future planting and consumption. However, stored seeds are highly susceptible to biodeterioration caused by various biotic and abiotic factors, with fungal contamination being one of the most significant threats. Soybean (*Glycine max)* and safflower (*Carthamus tinctorius*) seeds, due to their high oil and protein content, are particularly prone to fungal attack during storage, especially under suboptimal conditions. Fungi such as *Aspergillus spp., Fusarium spp., and Penicillium spp.* are known to colonize seeds, resulting in physical, chemical, and biological deterioration. This process not only reduces seed viability and germination rates but also poses serious health risks due to the production of mycotoxins, which can contaminate the food supply chain. Environmental factors like temperature, relative humidity, and seed moisture content play a pivotal role in influencing the growth and activity of these fungal pathogens. Soybean and safflower are economically important crops globally, valued for their applications in food, feed, and industrial products. The biodeterioration of their stored seeds has far-reaching implications for agricultural productivity and market value. Despite the significance of this issue, there is limited research on the comparative analysis of fungal contamination and biodeterioration in these seeds under varying storage conditions. This study aims to evaluate the fungal biodeterioration of soybean and safflower seeds during storage, identify the predominant fungal species responsible, and assess the impact of storage conditions on seed quality and viability. The findings will provide insights into effective storage management practices and strategies to mitigate fungal contamination, thereby safeguarding seed quality and agricultural sustainability.

## Material and Methods

1. Sample Collection: Seed samples of soybean (*Glycine max*) and safflower (*Carthamus tinctorius*) were collected from various storage facilities, including warehouses, traditional storage structures, in different geographic locations. A total of 50 samples (25 soybean and 25 safflower) were collected, each weighing approximately 500 grams. The storage conditions, including temperature, humidity, and duration of storage, were recorded for each sample.

2. Isolation of Fungal Contaminants :Fungal isolation was carried out using the standard dilution plate method and direct plating technique:

Dilution Plate Method: Ten grams of each seed sample was ground into powder and serially diluted with sterile distilled water. Aliquots were plated on to potato dextrose agar (PDA) medium.

Direct Plating Technique: Seeds were surface sterilized using 1% sodium hypochlorite, rinsed with sterile water, and directly plated onto PDA medium. Plates were incubated at 28 ± 2°C for 5-7 days, and fungal growth was monitored.

3. Identification of Fungal Species

Fungal colonies were identified based on morphological characteristics, including colony color, texture, and sporulation patterns, under a stereomicroscope. For precise identification, lactophenol cotton blue staining was used, and species were confirmed using fungal identification manuals.

4. Assessment of Biodeterioration :

The biodeterioration in seeds was evaluated by:

Seed Germination Test: Conducted according to ISTA guidelines to determine germination percentages.

Seed Moisture Content: Measured using the oven-dry method to assess moisture levels in stored seeds.

Mycotoxin Analysis: Samples were screened for the presence of mycotoxins, such as aflatoxins, using thin-layer chromatography (TLC).

Weight Loss Measurement: The percentage weight loss of seeds was calculated by comparing initial and final weights.

Seed Quality Analysis: Visual observations were recorded for discoloration, texture changes, and odor.

5. Environmental Parameters

Environmental factors, including temperature and relative humidity of the storage facilities, were recorded using digital thermohygrometers. These parameters were correlated with the fungal growth and extent of seed biodeterioration.

**Observation Table**

Biodeterioration of Soybean and Safflower stored seeds by fungus

| Seed | Sample | Storage Duration (Months) | Temperature (Ç·) | Relative Humidity (%) | Fungal Species Identified | Moisture Content (%) | Germination Rate (%) | Mycotoxin detected | Weight Loss (%) | Visual Deterioration |
|---|---|---|---|---|---|---|---|---|---|---|
| Soybean | S1 | 3 | 28 | 70 | *Aspergillus .flavus* | 12 | 85 | Aflatoxins | 2.5 | Minor discoloration |
| | S2 | 6 | 30 | 75 | *A.niger Fusarium spp* | 14 | 72 | Aflatoxins | 5.2 | Discoloration,Odour |
| | S3 | 9 | 32 | 80 | *Fusarium spp Penicillium Spp.* | 16 | 58 | Fumonisins | 8.7 | Severe |
| Safflower | SF1 | 3 | 28 | 70 | *Penicillium Spp.* | 10 | 88 | None | 2.0 | Minor discoloration |
| | SF2 | 6 | 30 | 75 | *Aspergillus .flavus Fusarium spp.* | 13 | 78 | Aflatoxins | 4.3 | Minor discoloration |
| | SF3 | 9 | 32 | 80 | *Aspergillus niger Fusarium spp,Penicilliu m* | 15 | 65 | Aflatoxins Fumonisins | 7.9 | Discoloration,Odour |

Fungal Species Identified: Determined through isolation and morphological analysis.
Seed Moisture Content: Measured using the oven-dry method.
Germination Rate: Conducted via seed germination tests under controlled conditions.
Mycotoxins Detected: Assessed using thin-layer chromatography (TLC).
Weight Loss: Calculated as a percentage of initial seed weight.
Visual Deterioration: Includes discoloration, texture changes, and odor due to fungal contamination.
This Obervation highlights the influence of storage duration, environmental factors, and fungal species on the biodeterioration of soybean and safflower seeds.

Results

The evaluation of biodeterioration in stored soybean (Glycine max) and safflower (Carthamus tinctorius) seeds revealed significant fungal contamination and its detrimental impact on seed quality. The results are summarized as ,Fungal Contamination Soybean seeds showed higher fungal diversity and contamination levels compared to safflower seeds.The predominant fungal species isolated were *Aspergillus flavus, Aspergillus niger, Fusarium spp., and Penicillium spp.*Fungal growth was most pronounced in samples stored for longer durations (≥6 months), particularly under high temperature (30–32°C) and humidity (≥75%) conditions. Seed Moisture Content,The moisture content of seeds increased with storage duration, with soybean seeds reaching up to 16% and safflower seeds up to 15% in long-term storage. High moisture levels correlated with increased fungal growth and mycotoxin production. Germination rate The germination rates of both soybean and safflower seeds declined over time due to fungal contamination.Soybean seeds showed a steeper decline, with germination rates dropping from 85% at 3 months to 58% at 9 months.Safflower seeds exhibited a lesser decline, with rates decreasing from 88% to 65% over the same period.Mycotoxin Production Aflatoxins were detected in samples contaminated with *Aspergillus flavus and A. niger,* particularly in soybean seeds stored for more than 6 months. Fumonisins were detected in samples with Fusarium spp. contamination, affecting both soybean and safflower seeds.Weight Loss Soybean seeds experienced greater weight loss (up to 8.7%) compared to safflower seeds (up to 7.9%) due to fungal enzymatic activity and deterioration.Weight loss was directly proportional to the severity of fungal contamination and storage duration.Visual Deterioration seeds exhibited severe discoloration, texture changes, and a musty odor in samples stored for 9 months.Safflower seeds showed relatively less visual deterioration but still exhibited minor discoloration and odor in long-term storage.

**Conclusion**

The evaluation of biodeterioration in stored soybean (*Glycine max*) and safflower (*Carthamus tinctorius*) seeds has highlighted the significant impact of fungal contamination on seed quality, viability, and safety. The study identified key fungal species, including Aspergillus flavus, *Aspergillus niger, Fusarium spp., and Penicillium spp.,* as primary contributors to biodeterioration. These fungi not only caused physical and biochemical deterioration of seeds but also produced harmful mycotoxins, such as aflatoxins and fumonisins, which pose serious health risks.

Soybean seeds were found to be more prone to fungal biodeterioration than safflower seeds due to their higher moisture content and nutrient composition. Prolonged storage under high temperature and humidity conditions exacerbated fungal growth, resulting in reduced germination rates, weight loss, and visual deterioration. Key recommendations include, Maintaining low moisture levels in stored seeds to inhibit fungal growth.

Storing seeds in cool, dry environments with controlled temperature and humidity. Utilizing antifungal treatments and coatings to prevent fungal colonization. Conducting regular monitoring of stored seeds for early detection of contamination. By implementing these strategies, biodeterioration can be significantly minimized, ensuring the longevity, viability, and safety of stored seeds. The findings of this research provide valuable insights for farmers, seed storage facilities, and policymakers in developing sustainable storage solutions to safeguard agricultural productivity and food security.

**Discussion**: The present study highlights the significant role of fungal contamination in the biodeterioration of stored soybean (*Glycine max)* and safflower (*Carthamus tinctorius)* seeds. The findings indicate that fungal species such as *Aspergillus flavus, Aspergillus niger, Fusarium spp*., and *Penicillium spp*. are the primary agents responsible for seed quality degradation. These fungi thrive under specific environmental conditions, particularly high temperature and humidity, which were prevalent in the storage facilities examined in this study.

Fungal Susceptibility of Soybean and Safflower Seeds Soybean seeds were found to be more susceptible to fungal attack than safflower seeds. This can be attributed to their higher oil and protein content, which provide an ideal substrate for fungal growth. In contrast, safflower seeds, though also prone to fungal contamination, exhibited relatively greater resistance, likely due to differences in their biochemical composition. The results align with previous studies that reported soybean seeds to be more vulnerable to biodeterioration under suboptimal storage conditions. The study demonstrated a clear correlation between storage duration, environmental factors (temperature and humidity), and the extent of fungal contamination. Seeds stored for longer periods (6–9 months) under conditions of high humidity (≥75%) and elevated temperatures (≥30°C) exhibited increased fungal growth, reduced germination rates, and significant weight loss. These findings emphasize the critical need for controlled storage environments to minimize fungal activity and maintain seed quality. In conclusion, addressing fungal biodeterioration is critical for ensuring the quality, viability, and safety of stored seeds, thereby supporting food security and sustainable agricultural practices.

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