

Post-Harvest Damage to Food Grains by Insects: A Review

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Abstract: *Post-harvest loss of food grains is a significant concern that affects food security, economic stability, and sustainable agriculture. Insects are one of the most formidable challenges faced during the post-harvest phase, inflicting considerable damage to stored grains. This paper provides a comprehensive review of the types of insects that cause post-harvest damage, their biology and behaviour, the impact of infestation on grain quality and quantity, and effective management practices to mitigate their effects.*

Keywords: Insect pests, post-harvest, Insect infestation, weevil

1. Introduction

Food insecurity remains a pressing global issue, exacerbated by population growth and climate variability. It is estimated that one-third of all food produced for human consumption is lost or wasted each year, with post-harvest loss accounting for a significant portion of this figure. Insect pests are principal contributors to post-harvest loss, affecting grains such as rice, wheat, corn, and legumes. Grains serve as a crucial source of nutrition, especially with the world's population projected to reach 9 billion by 2040, necessitating a 71% increase in food production. Despite advancements in agricultural technology, improper storage leads to significant grain losses, estimated at 10-20% of overall production, primarily due to insect and pest infestations. Various environmental factors, such as temperature and humidity, along with biological factors like rodents and microorganisms, contribute to these losses.

In India, the tropical climate fosters year-round pest activity, with nearly 1, 000 insect species affecting stored grains. These pests not only damage the quality and quantity of grains but also pose health risks to humans through contamination. Major stored grain pests include rice weevils and flour beetles, with losses amounting to around Rs.20, 000 crores annually due to pest damage. Effective pest management practices and advancements in storage technology are critical to reduce these losses and ensure food security in a growing population.

Understanding the mechanisms of insect damage is essential for developing effective storage practices and management strategies and improving the nutritional availability of grains worldwide.

2. Materials and Methods

In Kalaburagi city, pests affecting stored grains, cereals, and pulses were collected from national shops and the FCI, using a sampling method that involved taking 500 g of grain from the top, middle, and bottom of storage structures. Grains were collected in plastic bags along with accompanying pests, including their immature stages, and brought to the laboratory for sorting and photographic documentation. The samples included wheat, jowar, green gram, red gram, Bengal gram, and rice.

Pests were identified under the order Coleoptera using a hand lens, and grain damage was assessed using count and weighing methods. The percentage of insect-damaged grains was calculated based on the presence of holes in seeds, while grain weight loss was determined by weighing damaged and undamaged grains and applying specific formulas. This study highlights the critical assessment of pest-related grain damage and weight loss, essential for understanding storage losses and improving pest management strategies.

3. Result

Table 1: Number of Pests Sampled from sorghum, Wheat, Green gram, Red gram, Pea and Rice.

S. No	Name of the pest	Order	Scientific Name
1	Rice weevil	Coleoptera	<i>Sitophilus oryzae</i>
2	Pea weevil	Coleoptera	<i>Bruchus pisorum</i>
3	Wheat weevil	Coleoptera	<i>Sitophilus ganarius</i>
4	Saw-toothed grain beetle	Coleoptera	<i>Oryzaephilus surinamensis</i>

Table 2: Pest Damage (% Number) of food Grains.

S. No	Name of the Grain	Weight loss (%)
1	Red gram	7.7 %
2	Green gram	46.71 %
3	Bengal gram (Chick pea)	15.82 %
4	Rice	17.77 %
5	Wheat	51.97 %
6	Jowar	41.99 %

Pest Control Methods

Household measures to control losses during storage: Household practices using locally available plant products are effective for protecting food grains and offer advantages over scientific methods due to their cost-effectiveness and accessibility. This knowledge arises from the skills and experiences gained through interaction with the environment. By utilizing these household products, the quality of grains for feeding purposes remains uncompromised. Nature provides plants with numerous medicinal and herbal properties, such as neem (*Azadirachta indica*), turmeric, and tulsi. Additionally, proper drying of grains and storage spaces is crucial. Here are some home strategies for protecting food grains.

Traditional Practices for Protecting Food Grains:

Historical Context: Rural communities have utilized natural resources for food grain storage for centuries, based on the accessibility and effectiveness of these methods.

Neem Leaves:

- Usage: Fresh, dried neem leaves are mixed with stored grains.
- Benefits: Acts as a pest repellent; safe, inexpensive, and effective.
- Active Compounds: Contains azadirachtin, azadirone, and nimbin, which deter pests.
- Application: Common among South Indian farmers for storing ragi.

Turmeric (Haldi):

- Usage: Mix 40 g of turmeric powder per kg of grains; rub gently and shade dry for 30 minutes.
- Benefits: Provides insecticidal properties; strong odor and bitter taste deter insects.
- Application: Can be used in its raw form for protection.

Chemical methods:

Chemical warehouses must be empty and sealed for effective fumigation. Dispersing agents may be used to ensure thorough penetration of the fumigants. Methyl bromide and phosphine are commonly used chemicals for warehouse fumigation. The duration of fumigation depends on the specific pest, commodity, and environmental conditions. Fumigation is often conducted on a schedule, such as every 45 days, to maintain pest control.

- Chemical warehouses must be empty and sealed for effective fumigation": This clarifies the first part of the original sentence, which was grammatically incorrect. It also highlights a crucial requirement for successful fumigation, that the area must be gas-tight.
- "Dispersing agents may be used to ensure thorough penetration of the fumigants": This expands on the "Dispersion are used pushdown" part, explaining the purpose of dispersing agents in aiding fumigant penetration.
- "Methyl bromide and phosphine are commonly used chemicals for warehouse fumigation": This simplifies and makes the original statement more direct. Methyl bromide, though effective and fast-acting, has been subject to phase-out requirements due to its detrimental effects on the ozone layer. Phosphine is another commonly used fumigant for warehouse facilities.
- "The duration of fumigation depends on the specific pest, commodity, and environmental conditions": This provides context to the vague "At the time of days fumigation is the best method to contest". The effectiveness of fumigation relies on various factors including the exposure time and concentration of the fumigant, temperature, and humidity.
- "Fumigation is often conducted on a schedule, such as every 45 days, to maintain pest control": This retains the frequency mentioned in the original while presenting it in a clearer context. Routine fumigation can be a key part of an integrated pest management (IPM) approach to prevent re-infestation.

4. Discussion

The post-harvest phase is critical for ensuring food security and maintaining the quality and safety of grain products. Insects are among the most significant biological agents contributing to the degradation of food grains post-harvest. The impact of insect infestations on food grains can be profound, leading to both quantitative and qualitative losses. Therefore, understanding the dynamics of insect damage is essential for developing effective management strategies.

Insects can cause substantial losses to grains before they reach the consumer. Various studies indicate that, on average, post-harvest losses attributed to insect pests can range from 5% to 30% of the total harvest, depending on the grain type, storage conditions, and local infestations. Common pest species such as *Sitophilus granarius* (the granary weevil), *Tribolium castaneum* (the red flour beetle), and *Rhyzopertha dominica* (the lesser grain borer) are notorious for infesting stored products. The mechanisms of damage include feeding, contamination of grain with fecal matter, and the promotion of secondary microbial spoilage. Moreover, insect damage can lead to changes in grain chemical composition, affecting nutritional quality and safety.

In the present study *Sitophilus oryzae*, *Bruchus pisorum*, *Sitophilus ganarius* were recorded in green gram, Bengal gram, jowar, rice, wheat, and red gram grains.

The data presented in Tables 1 and 2 provide crucial insights into the pest dynamics affecting various food grains, and their resultant impact on grain weight loss. From Table 1, we can see that three primary pests have been identified: the Rice Weevil (*Sitophilus oryzae*), the Pea Weevil (*Bruchus pisorum*), and the Wheat Weevil (*Sitophilus ganarius*). All these pests belong to the Order Coleoptera, which is known for a wide range of economically significant species. The identification of these specific pests highlights the importance of targeted pest management strategies.

Table 2 reveals significant pest-induced weight loss in various grains, pointing to an urgent need for pest management interventions. Wheat showed the highest weight loss at 51.97%, indicating it is highly susceptible to pest infestation, particularly from the Wheat Weevil. Similarly, Green Gram and Jowar also experienced substantial damage, with weight losses of 46.71% and 41.99%, respectively. In contrast, Red Gram suffered the least weight loss at 7.7%, suggesting it may possess some level of resistance to the sampled pests, or it might be less frequently.

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