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Loose Smut of Wheat Grain and its Management: A Case Study of Ropar District

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ABSTRACT: *Ustilago tritici* is the source of loose smut of wheat, a serious seed-borne fungal disease that affects wheat crops all over the world. It is particularly common in Punjab, India's Ropar region. Food security and farmer livelihoods are impacted by the disease, which causes significant production loss and deteriorates grain quality. Using the Ropar district as a specific instance, this study examines the prevalence, symptoms, and management approaches of loose smut in wheat. During the 2023–2024 wheat growing season, field surveys, farmer interviews, and laboratory analyses were carried out. The study highlights how well integrated disease management strategies—which include resistant cultivars, seed treatment, and awareness campaigns—work. According to the results, strategic management techniques can guarantee sustainable wheat production in the area by drastically lowering the prevalence of illness.

Keywords: Ustilago tritici, wheat, fungal diseases, Ropar, Punjab, India.

INTRODUCTION

One of the most important cereal crops grown worldwide, wheat (*Triticum aestivum L.*) is essential to millions of people's food security. After rice, wheat is the second most important cereal crop in India, and Punjab contributes significantly to the country's wheat production. However, a number of biotic stresses affect wheat agriculture, and one of the most serious ones is loose smut, which is brought on by *Ustilago tritici.* A systemic fungal disease called loose smut is spread by contaminated seeds. The disease spreads throughout the plant after germination, eventually displacing the wheat spikelets with dark clusters of fungal spores. Early detection is challenging because the disease is frequently undetected until the later stage.

A sterile seed coat with a grain full of powdery mildew spores is produced by an irritated plant during the flowering stage of this illness. As a result, people rarely spread the disease. Its wounds can spread far and wide in the rain and air and are very contagious. While it also causes yield losses in arid regions, it often causes yield losses in cold, humid climates. Even 2% of the illness in the field can reduce output by up to 20%, and the seeds are unfit for future plantings, even though it does not cause large financial losses. The center of downy mildew, a seed-borne disease, is packed with dark brown to black telospores when it is ripe. The life cycle begins when the teliospores pass through the feathery stigma and enter the ovary during anthesis (Kashyap *et al*., 2019). Recombination and genetic diversity can occur when two distinct races infect the same spike under the right circumstances. When the contaminated seed sprouts, these spores also sprout. Without causing any outward symptoms, the pathogen spreads systemically from plant to plant and from cell to cell within the plant before reaching the cultivator (Menzies *et al.*, 2005).

In the Ropar district of Punjab, which has ideal weather conditions for smut growth and low farmer awareness, the disease continues to be a persistent problem.

The purpose of this study is to determine the prevalence of loose smut in Ropar, examine its impact on quality and production, and assess efficient management techniques appropriate for the area's small and medium-sized farmers.

MATERIALS AND METHODS

1. Study Area. The district of Ropar, often called Rupnagar, is located in Punjab, India's northeastern region. It is located between 30.97°N and 76.53°E, and its subtropical climate makes it a good place to grow wheat. Because of the area's moderate winter temperatures and average annual rainfall of 900–1000 mm, seed-borne fungal diseases are more likely to persist.

2. Data Collection. A mixed-method approach was used:

Field Surveys: Conducted during the Rabi season in 15 communities throughout Ropar (November 2023-April 2024).

Sample Analysis: The presence of *Ustilago tritici* was confirmed by laboratory analysis of suspected smut-infected plants.

Farmer Interviews: One hundred farmers participated in structured interviews to gauge their level of awareness and present management techniques.

3. Disease Incidence Estimation Disease incidence was calculated using the formula:

Disease Incidence (%) = (Total number of plants observed) /Number of infected plants × 100 (Agrios, 2005).

Seed Treatment: The following treatments were applied to seeds that were collected from contaminated fields:

a. biocontrol agent *Trichoderma harzianum, Pseudomonas fluorescens, Trichoderma viride*, and *Trichoderma koningii* (Harman, 2006).

b. Treatments with Fungicides

The suggested dosages of commercial fungicides were tested:

2.5% WP Mancozeb
50% WP copper oxychloride
1.5% EC proponazole
Tebuconazole 250 EC
25% EC of defenoconazole
50% WP carbendazim
Thiram 37.5% WS + Carboxin 37.5%
Tebuconazole 50% WG + Trifloxystrobin 25% WG (Singh & Kumar 2017).

4. Management Evaluation. Three main approaches to management were assessed: Systemic fungicide treatment of seeds.

Production of resistant cultivars. Programs for farmer awareness and training.

RESULTS AND DISCUSSION

1. Disease Incidence. According to field observations, the occurrence of loose smut varied from 1.5% to 6.3% in all fields surveyed, with fields using preserved, untreated seeds having a greater prevalence. Farmers that used certified treated seeds, on the other hand, reported infection rates that were less than 1%.

2. Symptoms and Identification

Typical symptoms included:

In the earheads, the wheat kernels are replaced with black, powdery aggregates. Early appearance of infected ears. Lack of typical grain growth. The presence of the spherical, dark brown, echinulate (spiny) *U. tritici* teliospores was verified by microscopic examination.

3. Farmer Practices and Awareness. 68% of farmers reused their own seed without treatment, according to survey data. Merely 15% had applied any fungicide treatments, and only 24% were aware of loose smut. Major obstacles were identified as lack of access to extension services and traditional misconceptions.

4. Management Efficacy

Seed Treatment: In trial plots, carboxin-treated seeds exhibited 95–98% disease suppression.

Resistant Varieties: Even without seed treatment, fields planted with PBW 725 and HD 2967 had a lower incidence of smut (<0.5%).

Awareness Campaigns: Evaluations conducted after training revealed a 40% rise in farmers' intention to use seed treatment techniques.

These results corroborate past research showing integrated management's efficacy (Singh *et al.*, 2021).

Table 1: Impact of Fungicides and Biocontrol Agents on the Incidence of Loose Smut in Wheat.

Sr. No.	Treatment	Disease Severity (%)	% Reduction Over Control
1.	Carboxin + Thiram	2.3	87.1
2.	Trifloxystrobin + Tebuconazole	3.1	86.0
3.	Propiconazole	3.2	85.2
4.	Tebuconazole	3.4	83.9
5.	Difenoconazole	4.1	80.9
6.	Carbendazim + Mancozeb	4.6	77.1
7.	Mancozeb	5.6	73.2
8.	Copper Oxychloride	6.3	71.0
9.	Carbendazim	5.7	73.1
10.	*Trichoderma harzianum*	6.2	71.9
11.	*Trichoderma viride*	7.1	68.1
12.	*Trichoderma koningii*	7.3	66.1
13.	*Pseudomonas fluorescens*	8.3	62.2
14.	Control	22.2	—

CONCLUSION AND FUTURE SCOPE

Due to conventional agricultural methods, limited knowledge, and seed-borne transmission, loose smut continues to have an impact on wheat productivity in the Ropar district. Nonetheless, disease control via fungicide treatment, resistant cultivars, and certified seed is quite successful. For these approaches to be widely adopted, farmer education and knowledge dissesmination are crucial.

It is advised that:

1. Government organizations and agricultural institutions regularly provide training and treated seeds in order to guarantee sustainable wheat production in Ropar and other agroclimatic zones.
2. The implementation of policies encouraging the distribution of certified seeds at reduced prices.
3. Research on resistant variants that are regionally adapted is still ongoing.

The present study has established a strong basis for comprehending the prevalence, consequences, and management of loose smut in the region of Ropar. Nonetheless, additional investigation and advancement are necessary to expand on these discoveries and guarantee sustainable, long-term sickness management.

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