

Field Report of Loose Smut of Barley, *Ustilago nuda* f.sp. *hordei*

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SUMMARY

Barley is one of the most important cereals grown thoroughly the world. It is mainly used in brewery industry for making malt. It is a store house of various vitamins and minerals. It is affected by various fungal and bacterial diseases among them loose smut is of foremost importance as it is internally seed borne thus its management is difficult. This disease can only be observed after panicle initiation thus it is difficult to observe in the early stages. So use of resistant variety like- C44, C50, CN292, CN 294 and NP13 is most important management. Seed treatment with systemic fungicide like Agrosan GN at the rate of 2.5g/kg seed prior to the sowing is recommended for the management of disease.

INTRODUCTION

Barley (*Hordeum vulgare*) is an economically, nutritionally and industrially important cereal crop worldwide. It is fourth most important cereal in the world after wheat, maize and rice. Ethiopia is believed to be centre of origin and diversity of cultivated barley crop. In India it is mainly grown in Uttar Pradesh, Punjab, Madhya Pradesh, Rajasthan, Bihar, Himanchal Pradesh, Haryana, West Bengal, and Jammu and Kashmir. Barley is affected by three Smuts, namely covered smut (*Ustilago hordie*), black semi loose smut (*Ustilago nigra*) and loose smut (*Ustilago nuda*). Root, foliar, and head plant diseases like smuts, commonly account for losses up to 25%. Barley loose smut is an internal seed borne disease found wherever barley is grown and is a serious threat to crop yields. However there are many biotic and abiotic factors that reduce production and productivity of the crop. Of the various fungal plant diseases limiting barley productivity, loose smut (*Ustilago nuda*) is one of the major cosmopolitan and destructive seed borne pathogen in many barley producing regions of the country. Loose smut on average causes estimated grain yield loss of 25-30%.

Causal organism

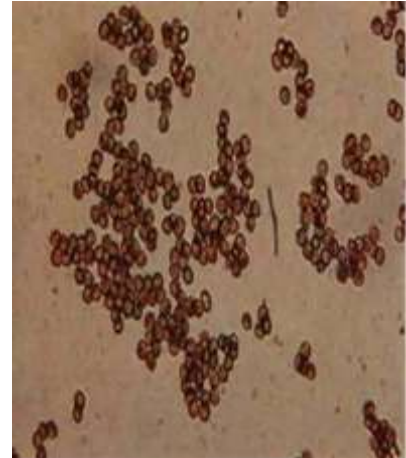
Loose smut of barley is caused by *Ustilago segetum hordei* (*Ustilago nuda*). The fungus attacks different species of *Hordeum* and a number of grasses. 13 races of the barley loose smut fungus have been found till 1965.

Taxonomic Position

Kingdom – fungi
Diviaion- Basidiomycota
Class- Ustilaginomycetes
Order- ustiginales
Family- ustilaginaceae
Genus – *Ustilago*
Species- *nuda*

Symptoms

- Barley loose smut symptoms commonly appear at the flowering stage and become apparent at heading or boot stage.
- The meristematic tissue plays an important role for the passive spread or distribution of the pathogen.
- The symptoms become obvious between heading and maturity.
- Barley heads are initially black to dark brown and some diseased heads may be taller than any of their neighbouring healthy plants.
- The sori are formed in the spikelet.
- In early stages they are covered by a thin, silvery membrane which ruptures while the ear is emerging out of the sheath.
- The loose spore mass is shed, or blown away by wind leaving behind bare rachis.
- Early symptoms of the disease, before flowering can be detected sometimes by the discoloration of the leaves.

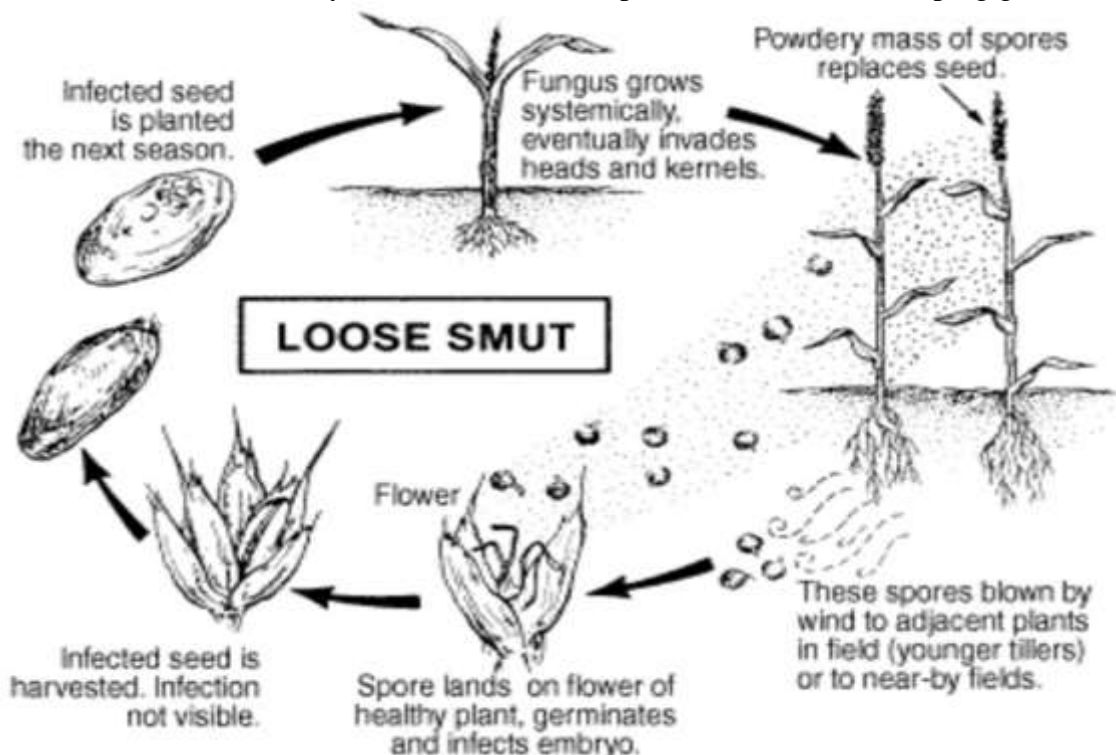


Somatic Structure

- Spores of *Ustilago segetum hordei* are nearly round, olive Brown, lighter on one side than the other, finely echinulate, and measure 5-9nanometer in diameter.
- The hyphae penetrate the pericarp and pass through Parenchyma along the testa on the ventral side of the grain and cross the basal endosperm to enter the scutellum.
- From there they enter various parts of the embryo specially the hypocotyl and growing roots.
- Mycelium is intracellular in pericarp and testa and mainly intercellular in the aleurone, endosperm, scutellum and embryo.
- It produces hyaline, dikaryotic hyphae.

Pathogenesis

- Floral infection is initiated by teliospores landing on the open flowers.
- Teliospores germinates and infects developing seed embryo in the host flower and survives to the next host generation as dormant mycelium in the embryo of the seed.
- The mycelium breaks dormancy when the barley seeds germinate.
- Then it penetrates all spikelet tissues except the rachis and the awns.
- At flowering the teliospores are blown away by wind from the infected spikes and infect spikes of healthy plants where the spores settle in healthy flowers.
- They germinate and infect the embryo at the same time of pollination of the developing grain.



Life Cycle

It is a monocyclic disease. The infected seed develops normally, but contains the fungus as dormant mycelium inside the embryo. The life cycle of *Ustilagonuda* comprises of primary infection at flowering, survival in form of spores/ mycelium inside the seed, secondary infection in the form of systematic infection at seeding stage upon germination and prior to emergence, symptom expression with smutted heads at flowering releasing the teliospores and there dissemination by wind. The teliospores germinate and the resulting hyphae penetrate the developing seed to complete the life cycle.

Survival and Transmission of the pathogen

It survives from one growing season to the next or between crop cycles as a dormant mycelium only in the endosperm and within the embryo of infected barley seeds, and the fungus can survive long term storage of the seeds. Teliospores are disseminated by rainfall splashes, insects, wind and other agents.

Epidemiology

- The warm soil is more conducive to loose smut than cool soil.
- Cool and damp weather at flowering time is necessary for infection.
- Loose smut is common in cool high rainfall areas.
- Temperature of 15-22° C promotes infection to spread.
- Single heavy rain during flowering in affected field can cause a 10-20 fold increase in infection.
- Excessive heat or dry air will lower germination of teliospores.



Sample Collection



Agriculture Department Farm, Shridhar University



Collected Sample



Infected Plant

A. Sample Collection Information

- Name- Prakhar Srivastava -Amrendra KumarYadav
- Date of Collection- 16- February- 2024
- Location- Agriculture department farm
- Name of crop- Barley
- Variety-RD 2552
- Infected plant part- Spike
- Field Condition- Dry and warm soil with no water logging.
- Weather parameter

Date	T. Max. (C ⁰)	T. Mini. (C ⁰)	Humidity (100%)		Cloud Cover (octa)	Wind speed (mph)
			Max.	Mini.		
11-Feb2024	22.7	8.8	100	33	2	2.6
12-Feb-2024	21.1	10	100	49	1	2.2
13-Feb-2024	22.2	11.1	100	46	0	1.9
14-Feb-2024	22.7	11.1	100	41	3	4
15-Feb-2024	23.8	11.1	100	29	0	3.3
16-Feb-2024	25	11.1	100	17	0	2.8
17-Feb-2024	25	11.1	94	26	1	3.2
18-Feb-2024	27.7	11.1	94	26	0	6.3
19-Feb-2024	26.1	16.1	100	34	0	9.8
20-Feb-2024	27.2	16.1	100	32	0	4.1
21-Feb-2024	26.1	12.7	94	24	0	5.5

B. Disease Intensity: 6 plants were infected in one block of the field.

C. Diagnosis and detection: Disease symptoms of loose smut of barley are obvious after seeing dark brown heads with masses of teliospores. Affected heads were taller than the other plants which increases the possibility of loose smut

Recommendation for the farmer:

- Disease can be controlled by the use of resistant varieties, like- C44, C50, CN292, CN 294 and NP 13 are tolerant varieties.
- Hot water treatment or solar energy treatment can also be used. In this the seed is soaked in cold water from 6am. -10am on a bright sunny day in june and to exposed to sun on a brick floor from 10am- 5pm, when the temperature of floor is 40- 50 degree.
- Economic control can be achieved by seed treatment with protectant or systematic fungicide. Agrosan GN at the rate of 2.5g/kg seed.
- Leaf extract of Margosa (*Azardirachta indica*) also reduces the spore germination of *Ustilago hordie*.

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