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Brief Report

Reemergence of Wheat Common Bunt After Three Decades in Pakistan

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Abstract

Common bunt is a serious disease of wheat that may lead to yield losses in many regions of the world and can reduce yield and flour quality. Fifty wheat heads were randomly sampled from each of the six fields during a survey for disease diagnosis during the 2020 cropping season from the Seenlast area of district Chitral located in the Hindu Kush region of Pakistan. Field observations were recorded and diseased heads, bunted balls, and spores derived from bunted balls were morphologically examined using stereo and compound microscopy. Based on the disease symptoms and teliospore morphology of the studied 300 samples, the fungus was identified as *Tilletia laevis*, the cause of the common bunt of wheat. Disease prevalence was detected in 10-36% of the studied samples. It is the first report of common bunt occurrence from Chitral, the northernmost district of Pakistan, which confirmed the re-emergence of the disease after three decades in the country.

Keywords: common bunt; *Tilletia laevis*; reemergence; wheat; grains

Introduction

Common bunt caused by *Tilletia caries* (D.C.) Tul (= *T. tritici*) and *T. foetida* (Wall.) Liro (= *T. laevis*) occurs frequently in most of the global wheat-growing areas and causes huge losses in wheat yield and quality (Gaudet and Menzies 2012; Madenova *et al.*, 2021). In the infected plants, kernels are filled with bunt balls that are full of spore masses of the common bunt (Goates, 1996). In addition, the harvested healthy grain is rejected by millers due to its noticeable odor in the wheat kernel and flour (Yorgancilar, 2016). Since the introduction of effective chemical seed treatments, common bunt has lost its great importance in conventional wheat production. However, common bunt re-emerged in organic and low-input subsistence wheat farming. Historically, common bunt occurred and was not reported after the period 1971-75 and 1988-90 (Mirza *et al.* 1982; Mirza and Khan 1983; Khan *et al.* 1995) where it was confined to low-altitude districts in Pakistan. No information on the occurrence and geographical expansion of common bunt of wheat is reported from the high-altitude district of Chitral, Pakistan. This paper reports for the first time the occurrence of wheat common bunt from district Chitral located at a height of around five thousand feet in the Hindu Kush region of Pakistan.

Material and Methods

Under the framework of the Khyber Pakhtunkhwa wheat traveling seminar, a survey of a wheat-growing area of Chitral (Coordinates: 36°15'N 72°15'E) was conducted in 2020. The study area along with other parts of Pakistan and surrounding international regions is shown in Figure 1. The survey was executed during the wheat seed dough development and ripening period which corresponded to Zadoks crop stages 83-92 (Zadoks *et al.*, 1974). Prevalence of disease symptoms ranged from 5-10%

in the sampled wheat fields of 1-1.5 acre. Fifty heads from each of the six wheat fields were randomly collected in paper envelopes and during sampling crop features and prominent characteristics and symptoms relevant to disease were noted. Soon after collection, sampled heads were shifted to NIFA for further lab study and diagnosis. Samples were dried for 48 hours on lab benches under ambient temperature. Relevant morphological characteristics of diseased heads and bunted balls were investigated using a field guide for wheat diseases and pests (Prescott et al. 1986) and a direct inspection test (Asaad *et al.*, 2009) while spores were isolated from intact bunt balls, embedded in Hoyer’s fluid (Cunningham, 1972) and determined using compound microscope considering the main differentiation criteria shape and features of teliospores surface (ISTA 1984; Vánky 2012). The infection percent of each sample (% infected heads) was calculated by dividing infected heads over health heads X100.



Figure 1. Study district in Khyber Pakhtunkhwa along with other provinces of Pakistan and surrounding regions.

Results and Discussion

Field and Lab study for diagnostic signs and symptoms regarding wheat common bunt was carried out and infection percent (% infected heads) of each sample is presented in Table 1. Common bunt is not easily identifiable until the time the wheat heads and bunt balls often become visible after the soft dough stage. During field observations, it was noted that wheat crops in the sampled fields were not uniform and infected plants were slightly stunted while flag leaves of infected plants occasionally showed yellow streaks. Bunted balls were visible (Figure 2) and infected wheat heads were usually slightly lighter in color and often exhibited a slight bluish-gray color in comparison to healthy heads. Characteristic symptoms of wheat common bunt observed in the field were similar to those reported in “The Encyclopaedia of Cereal Diseases” (ahdb.org.uk/cereal-dmg) and elsewhere (Report on Plant Disease 1987).



Figure 2. Bunted balls were visible in infected wheat heads.

Table 1. Detection of common bunt (CB) in wheat heads sampled during 2020 from six randomly selected fields in the Seenlast area of Chitral.

Field Number	Heads Sampled (Number)	CB infected heads (Number)	CB infected heads (%)
Field 1	50	10	20
Field 2	50	15	30
Field 3	50	10	20
Field 4	50	18	36
Field 5	50	12	24
Field 6	50	05	10

Lab examination of common bunt sampled wheat heads displayed bluish green color and glumes and awns were spread (Figure 3) which are prominent symptoms of common bunt-infected wheat heads reported by Agrios (2005). Symptoms of kernels in heads indicated that kernels were replaced by smut balls which were short, plump, and had a dull gray-brown color (Figure 4). Furthermore, smut balls composed of a mass of oily, dark-brown teliospores (Figure 4) with foul-smell or fishy odor, and smut balls appeared like normal kernels which correspond to the documented symptoms (Report on Plant Disease 1987; Wilcoxson and Saari, 1996).



Figure 3. Glumes and awns were spread apart and fungal structures "bunt balls" are visible in the spikes.



Figure 4. Symptoms of kernels transformed into smut balls full of spores.

Considerable overlaps exist in the characteristics of the teliospores of *Tilletia* spp. making identification difficult (Murray et al., 1998). Teliospore wall morphology was used as the criteria for fungus identification involved in common bunt initiation. Teliospores observed under a compound microscope had a light pale to dark olivaceous brown appearance. The spore's structure was globose, ovoid, and occasionally elongate but occasionally smaller while teliospores had smooth spore walls (Figure 5).

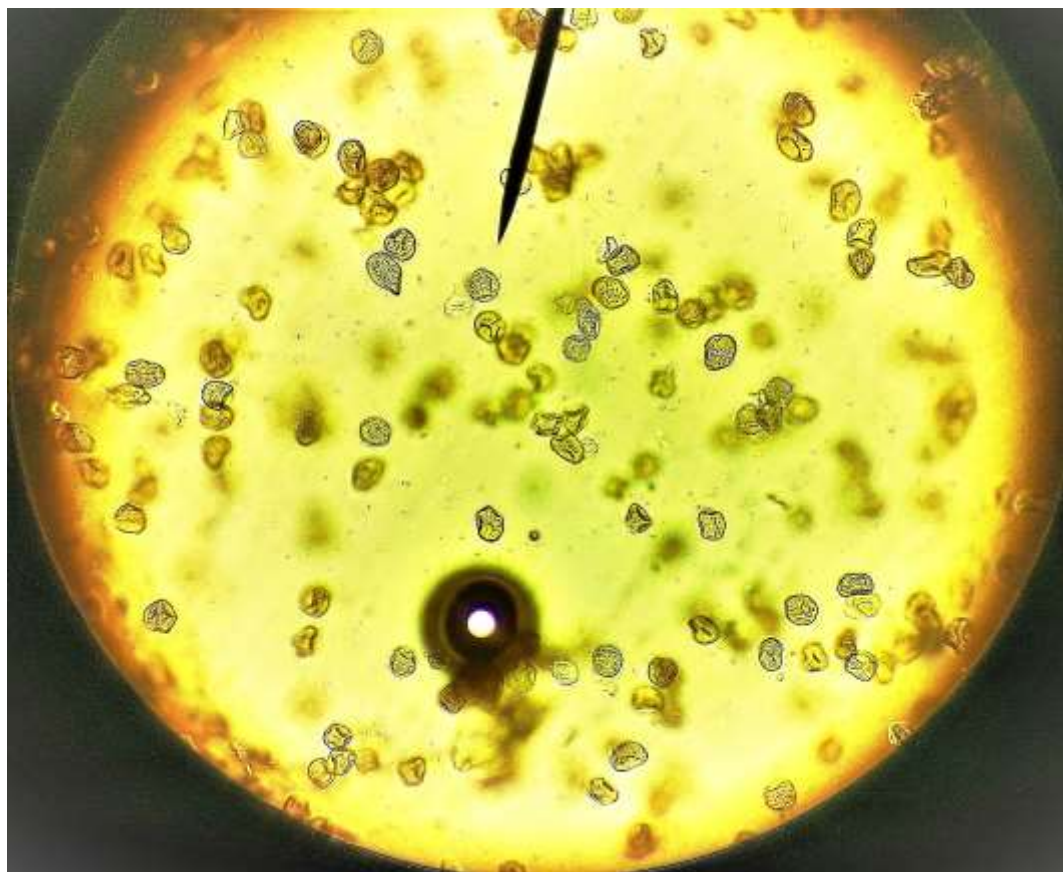


Figure 5. Teliospores morphology of *T. laevis* observed under the compound microscope at 40X magnification.

Based on the disease symptoms and teliospore morphology of the studied samples, the bunt fungus was identified as *T. laevis* and previous reports (Wilcoxson and Saari 1996; Mathre 2000; Pieczul *et al.*, 2018) support the findings of the current study. Furthermore, it was also documented that the common bunt of wheat in Pakistan is due to *T. laevis* (Khan *et al.*, 1995). To the best of our knowledge, this paper reports the re-emergence of the common bunt in the country after three decades and its detection for the first time from the Chitral district of Pakistan. Food insecurity presents a pressing challenge in the Chitral district of Pakistan, as underscored by the findings of the 2009 Food Security Assessment (FSA) report. The region contends with a myriad of socio-economic factors that exacerbate this issue. Among these challenges, common bunt, caused by a pathogenic fungus, emerges as a significant threat due to its ability to spread through both seeds and soil. This dual transmission mechanism markedly heightens the risk it poses to wheat production, which serves as the primary crop for the region's predominantly low-input farming systems. Given the prevalence of traditional agricultural practices in Chitral, characterized by limited access to modern technologies and resources, the vulnerability to common bunt becomes even more pronounced.

To mitigate the impending threat of common bunt and its detrimental impact on food security, concerted efforts must be orchestrated across various fronts. This entails implementing stringent monitoring protocols to detect and trace the spread of the pathogen, raising awareness among farmers regarding preventive measures and integrated pest management strategies, and allocating resources towards research and development aimed at identifying resilient wheat varieties and promoting sustainable farming practices. By addressing these challenges comprehensively, stakeholders can work towards safeguarding food security and bolstering the resilience of agricultural systems in the Chitral district.

Conclusions and Recommendations

Common bunt of wheat was a prevalent and emerging disease that needs to be addressed as the pathogen is both seed and soilborne and can become a risk to wheat production in low-input farming practiced in district Chitral.

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Novelty Statement: It is the first report of common bunt occurrence from Chitral, the northernmost district of Pakistan, and also confirmed the re-emergence of disease after three decades in the country.

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