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First report of the smut pathogen on tef (*Eragrostis tef)* in Ethiopia

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ABSTRACT

Aim: The survey aimed to collect unusual tef disease samples observed in the field and report the newly recorded disease.
Materials and Methods: The samples from diseased tef varieties were collected and observed under a microscope directly without culturing because the pathogen is obligate.
Results: The smut spore cells with slightly circular shapes were observed and identified. The smut species of tef can attack the organ of the tef productive part before heading of the crop. On the infected part of the tef swelled filled with teliospores were observed. The disease was observed on Quncho, Magna, and Boset at Southern Nation nationality of People around Alaba zone and West Arsi Zone around Negelle Arsi and Shashemene (Oromia) in Ethiopia. The diagnosis was easily confirmed by planting imbibed and un imbibed Quncho variety in the greenhouse. On the imbibed tef with teliospores of smut gives some symptoms observed in the field and nothing observed in the unimbibed tef variety Quncho.
Conclusion: It was concluded that species-level identification of this pathogen, evaluation of tef genotypes against this disease and host range identification may future work of the pathogen.

Keywords: EragrostidisTef, Imbibed, Quncho, Smut, Variety.

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Introduction

Tef [*Eragrostis tef* (Zucc.) Trotter] is an indigenous staple cereal crop of Ethiopia. There is no doubt that tef is a very ancient crop in Ethiopia, where domestication took place before the birth of Christ. Tef is an important cereal crop in Ethiopia. In 2018/19, it was estimated that tef made up to 24.17% of all the cultivated area in Ethiopia, covering about 3.1 million hectares and grown by 7 million farmers (CSA, 2018/19). Tef is grown in almost all regions of the country for home consumption since it is a preferred grain, and for the local market, since it fetches the highest grain price compared with other cereals and is used as a cash crop by farmers. Although the crop is dominantly cultivated as a sole crop, it is also grown as an intercrop or mixed crop, relay crop, or in rotation with several types of crops (Hundera et al., 2001).

The crop is grown both in Belg (short rainy season) and Meher (long rainy season). The regions in Ethiopia identified as highly suitable for tef production include Gojam and Shewa, which are located in the central highlands of Ethiopia and are also the largest and major tef production areas in the country modern varieties are used as well as traditional landraces and local cultivars. Tef is often considered as a relatively healthy crop since it suffers very little from epidemics of pests including diseases as compared to most other crops grown in the country (Assefa et al., 2011 and Chanyalew et al., 2019). This has, amongst others, been because the crop species being an indigenous ancient crop originated and domesticated in Ethiopia before the Semetic invasion of 4000-1000 BC (Ponti, 1978), it has co-evolved with the pathogens and other pests over the millennia of its cultivation (Badebo, 2013). Currently, tef production during Belg (short rainy season starting from End of February- End of May) is common in the West Arsi zone of Oromia. This study was done to

report the newly emerging tef disease after identification of the pathogen in the country.

Materials and Methods

This Tef diseases survey was made during the short rainy season (Belg) and main season (Meher) curried out in major tef growing areas in 2019/20 G.C in the country. Fields were assessed from heading to maturity stages depending upon locations. At some pocket areas, unusual symptom was observed on tef varieties Quncho, and Magna, at West Arsi around Negelle Arsi and Shashemene. This disease was also observed in Southern nation nationalities and People region around Halaba Zone in Halaba woreda.

The symptoms rapidly progressed to plant death, with 5-10% of plants in an area of a few hundred square feet being affected especially around Halaba areas in southern nation nationality of people region. The infected plant samples were collected from each field. Plants swelled at mid of the cropped length during the heading of tef were collected. It is more swelled and black masses of spores (teliospores), observed in the infected part of the tef variety. The incidence of the disease was scored by counting the number of infected tef in the quadrant.

The collected samples were observed directly under the microscope to identify the spore shape and size directly without growth media because the pathogen is an obligate parasite in nature. The identification was done at Debre Zeit Agricultural Research Center in the plant pathology laboratory. The spores similar to that of oat smut were observed. Finally, to confirm the pathogen following Koch's postulate or principles: About 15-20 tef seeds (Quncho) were imbibed in water which contains the spores which were collected from diseased tef plants from the field. After thirty minutes the imbibed Quncho tef seeds of 15-20 planted/pots in the greenhouse and also unimbibed Quncho variety was planted as control.

Results and Discussion

Tef is often considered a relatively healthy crop since it suffers very little from epidemics of pests including diseases as compared to most other cereal crops grown in the country. Smut spp is the most destructive fungal disease on other cereal crops. The pathogen can infect the productive parts of the plants and the loss is 100% once the plant is infected by this pathogen at the maturity stage. The identity of smut disease has not been identified by authorized taxonomic. Figure a. and b. showed tef head infected by smut and spores shape observed under microscopy after collection from the field, respectively.

The infected spikelets contain masses of spores in place of grain. These spores are released before the normal grains mature, and they can be carried by wind and germinate on a suitable host. In the smut spp of tef, the smutted tef parts arise on plants that are already systemically colonized by the fungus. The embryos of the seeds are infected so that the infection is repeated in the following season.

The collected samples were directly observed under a microscope by placing them on the slide. Slightly circular shape and size of the spores were identified Teliospores are small, circular, measuring 5-10 µm in diameter was observed and measured. Circular teliospores were observed under the microscope (Fig b). These findings were corroborated by Assefa and Chanyalew (2018).

After identification of the pathogen for further confirmation; tef variety Quncho was planted in the greenhouse. After three months the same disease sign was observed on the imbibed tef variety and no disease sign was observed on the check or control pots planted without imbibition of tef with the inoculum collected from the field. Teliospores are small, circular, measuring 5-10µm in diameter (Fig b). The results were advocated by Badebo (2013).

Abundant teliospores were re-isolated from infected tef from the greenhouse (Fig a), thereby fulfilling Koch's postulates, and the same results were observed on the inoculated tef plants.

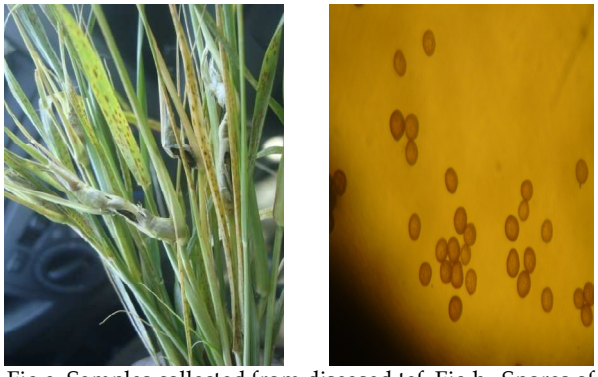

Fig a. Samples collected from diseased tef, Fig b. Spores of smut spp (10 x 40)

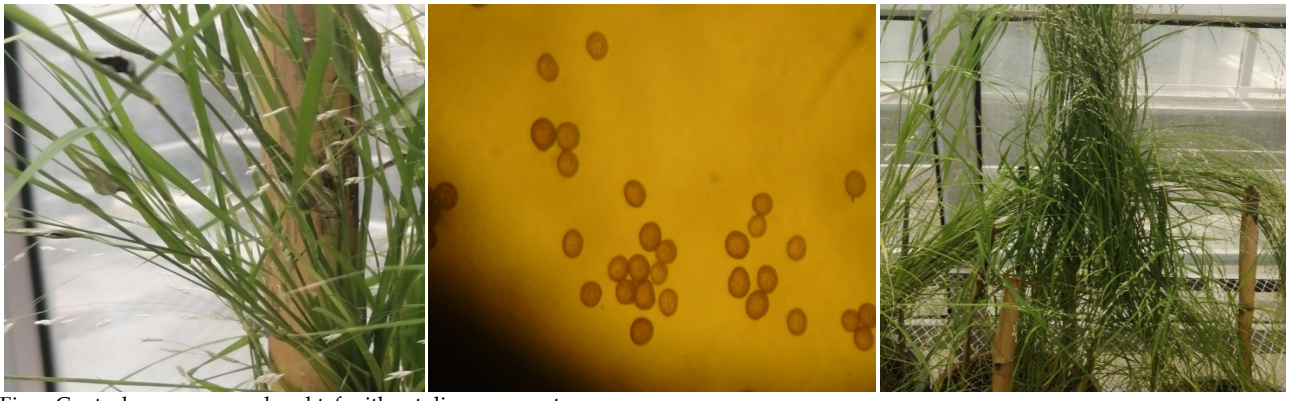

Fig c. Controls were sprayed and tef without disease symptom

The inoculation experiments were repeated twice and the same results were obtained. Controls were sprayed with a 0.25% gelatin suspension and no disease symptom observed (Figure c). CSA (2018/19) and Assefa and Chanyalew (2018) were also corroborated with the findings of the study.

Conclusion

It was concluded that species-level identification of this pathogen, evaluation of tef genotypes against this disease and host range identification may future work of the pathogen.

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