

Role of agronomic practices on the occurrence of *Fusarium* head blight of wheat

Okumu, O.¹, Muthomi, J.¹, Wagacha, M.², Narla, R.¹ & Mutegi, C.³

¹Department of Plant Science and Crop Protection, University of Nairobi, Kenya

²School of Biological Sciences, University of Nairobi, Kenya

³International Institute of Tropical Agriculture (IITA), Kenya

Corresponding author: oliverotieno182@gmail.com

Abstract

Fusarium head blight is a disease of small grain cereals that reduces yield and causes mycotoxin contamination. The role of agronomic practices on the occurrence of wheat agronomic practices was studied. In the experiment, a survey to determine wheat production practices was conducted in four agro-ecological zones in 2013 cropping season. *Fusarium* head blight incidence and severity was determined in four 1m² quadrants by counting infected heads and the proportion of diseased head respectively. Fungal contamination was determined by isolation on agar media and identified based on morphological and cultural characteristics. Majority of the farmers planted variety Njoro BW2, obtained certified seeds from Kenya Agricultural research institute, practiced crop rotation and applied soil amendments. *Fusarium* head blight occurrence was prevalent in all the regions but severity and incidence were low with *Fusarium graminearum*, *F. avenaceum* and *F. poae* isolated as the major causal agents. Wheat production practices influenced the level of inoculum in the soil, farmers' choice of variety Njoro BW2 known for moderate tolerance and wheat straw management could have resulted in low incidence and severity. Isolation of *F. graminearum*, *F. avenaceum* and *F. poae* in high incidence could indicate that these are the major causal agents of FHB in wheat growing regions. Wheat farmers need to apply better production practices that help reduce yield and the level of mycotoxin contamination.

Key words: Cereals, *Fusarium graminearum*, *Triticum aestivum*

Résumé

La fusariose est une maladie des petites céréales qui réduit le rendement et provoque la contamination par les mycotoxines. Le rôle des pratiques agronomiques sur l'apparition de pratiques agronomiques du blé a été étudié. Dans l'expérience, une enquête pour déterminer les pratiques de production de blé a été menée dans quatre zones agro-écologiques de saison de culture en 2013. L'incidence de la fusariose de l'*Fusarium* et la gravité ont été déterminées dans quatre quadrants 1m² en comptant les têtes infectées et la proportion de la tête malade respectivement. La contamination fongique a été déterminée par l'isolement sur gélose et identifié sur la base des caractéristiques morphologiques et culturelles. La majorité des agriculteurs avait planté la variété de Njoro BW2, et avait obtenues des semences certifiées de l'Institut de Recherche Agricole du Kenya et avait pratiqué la rotation des

cultures et l'amendement des sols. L'incidence en Fusariose était répandue dans toutes les régions, mais la gravité et l'incidence était faible avec *Fusarium graminearum*, *F. avenaceum* and *F. poae* isolés comme les principaux agents causals. Les pratiques de production de blé ont influencé le niveau d'inoculum dans le sol. Le choix des agriculteurs de la variété de Njoro BW2, connu pour sa tolérance modérée et la gestion de la paille de blé aurait pu aboutir à une faible incidence et gravité. L'isolement de *F. graminearum*, *F. avenaceum* and *F. poae* en haute incidence pourrait indiquer que ceux-ci sont les principaux agents responsables de la fusariose dans le blé des régions en croissance. Les producteurs de blé ont besoin d'utiliser de meilleures pratiques de production qui permettent de réduire le rendement et le niveau de contamination par les mycotoxines.

Mots clés: les céréales, *Fusarium graminearum*, *Triticum aestivum*

Introduction

Wheat (*Triticum aestivum*) is the second most important cereal crop after maize (*Zea mays*) in Kenya and the country relies on imports to bridge its domestic demand. This is largely due to the fact that production at national level is constrained by diseases especially *Fusarium* head blight (FHB). The disease is devastating for most cereal grains worldwide and it is caused by 19 *Fusarium* species including *F. avenaceum*, *F. culmorum*, *F. graminearum*, *F. poae* and *Michrodochium nivale*. The disease reduces yield and grain quality through shriveled kernels and contamination with mycotoxins. Despite these losses in grain quality aspects of agronomic practice that have potential to mitigate losses have not been adequately studied. Both tillage practices and cropping practices have been implicated to increase both severity and incidence of FHB. *Fusarium* head blight risk is directly dependent on the inoculum production potential. Crop residue potential on the soil surface provides substrate for ascospore production in conditions of warm weather, high humidity and precipitation, growing of wheat varieties that are susceptible increases the level of inoculum within the soil. This study was carried out to determine the influence of agronomic practices on the incidence and severity of FHB and the associated *Fusarium* species in Nakuru County, Kenya.

Materials and methods

A survey in four different agro ecological zones of Nakuru County was carried out at hard dough stage and at harvest during the 2013 cropping season. Both large and small scale were systematically sampled in each agro-ecological zone by selecting the third wheat growing farm in a transect to give 51 farms. A semi structured questionnaire was used to gather information on wheat production practices and samples of FHB infected spikes and harvested grain were collected for isolation of *Fusarium* spp. Incidence and severity of FHB was determined in four 1m² quadrants within each farm by counting the number of infected heads and the proportion of the heads showing FHB symptoms, respectively. *Fusarium* species were isolated by plating surface sterilised portions of the spike and kernels on low strength potato dextrose agar amended with mineral salts and antibiotics (Muthomi et al., 2002). Colonies of *Fusarium* spp. were sub-cultured on PDA and synthetic nutrient agar

(SNA, Nireberg, 1981) and identified based on cultural and morphological characteristics (Nelson *et al.*, 1983; Leslie and Summerell, 2006).

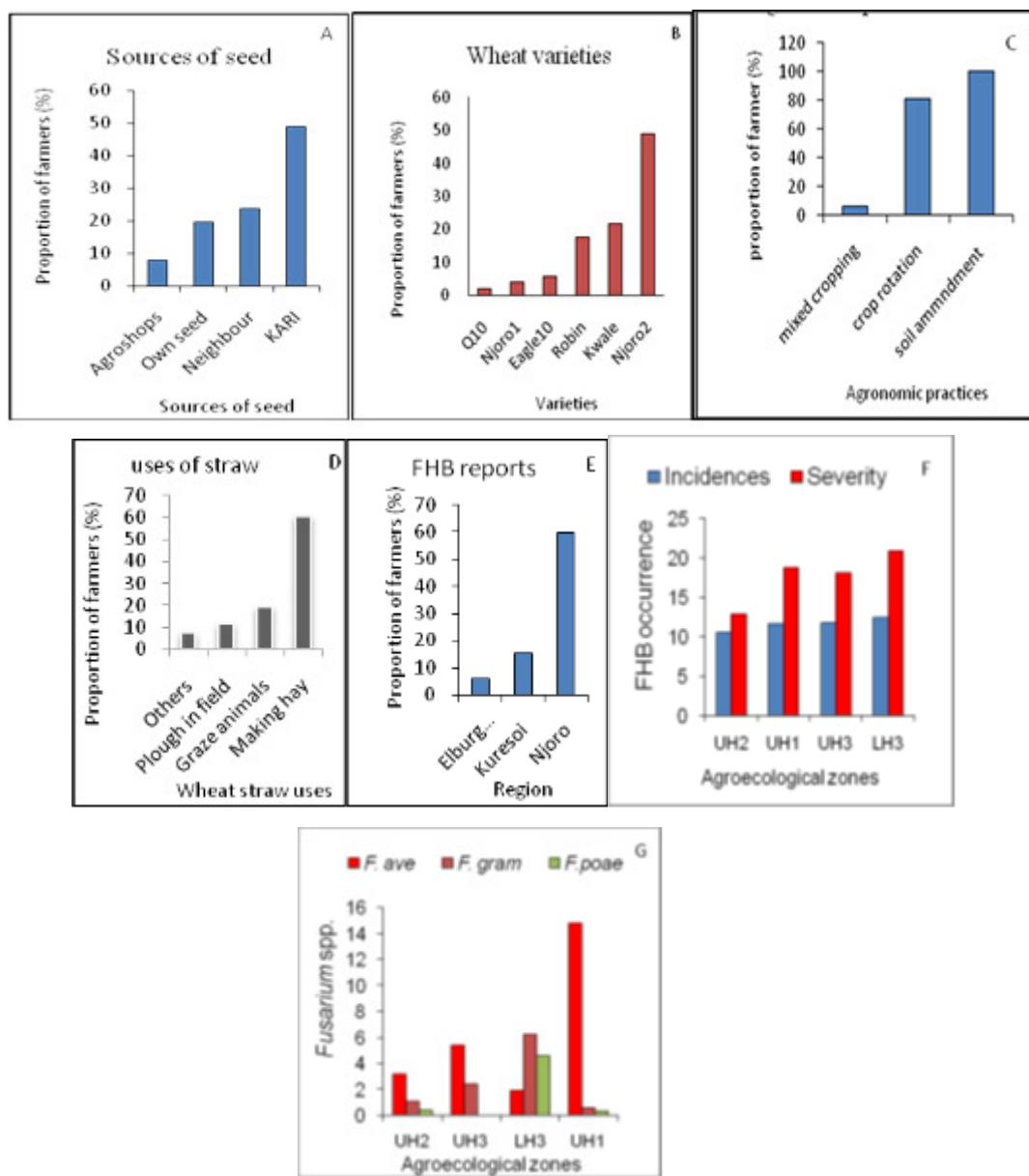


Figure 1. Percentage of wheat farmers who reported various agronomic practices in wheat production (A – Sources of seed, B- wheat varieties grown, C- agronomic practices, D – uses of straw) and the occurrence of FHB and the major strains isolated in different agro-ecological zones (E- % farmer reporting FHB, F – FHB incidence and severity, G – major FHB pathogens isolated).

Key: *F. ave* – *F. avenaceum*, *F. gram*- *F. graminearum*, and *F. poae*

Results

Majority of wheat farmers obtained certified seeds from the Kenya Agricultural Research Institute (KARI) (Fig. 1A) and Njoro BW2 was the most popular variety (Fig. 1B). Most farmers used wheat straws to make hay, practiced crop rotation and applied soil amendments (Fig. 1C). About 60% of the farmers reported presence of FHB and used fungicides to manage foliage diseases. *Fusarium* head blight was found in all the farms (Fig. 1F) with *F. avenaceum* and *F. graminearum* being the most frequently isolated strains (Fig. 1G).

Discussion

Although many wheat varieties were grown by farmers in all the agro-ecological zones, they were all susceptible to FHB. Majority of the farmers planted Njoro Bw2 due to its desirable qualities like lodging and disease resistance, and higher yielding potential when compared to other varieties. Majority of the farmers in Njoro region reported the presence of FHB in their farms. All the *Fusarium* species attacking cereals survive on crop debris saprophytically. Straw presence in the soil leads to increased inoculum, and thus; removal of these straws after harvesting with inclusion of rotational programmes with non cereal crops is suggested to reduce inoculum. Incidences of FHB in all the AEZs were low concurring with findings by Riungu *et al.* (2006). This could be due to weather conditions at the time of the survey and the choice of variety. Over six *Fusarium* species were isolated from the grain samples which shows that head blight in Nakuru is due to complex of *Fusarium* species. The species isolated at high frequencies were *F. avenaceum*, *F. graminearum* and *F. poae*. *F. graminearum* is considered most toxic and the most producer of Deoxynivalenol. The other species are also potential producers of mycotoxins but to a lesser extent. Management of FHB at all the growth stages and removal of wheat stubble is important in order to reduce infection and contamination by mycotoxins.

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