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Edit by

Giovanna Seddaiu
Paolo Benincasa

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Effect Of Durum Wheat Cultivar And Environment Conditions On The Content Of Modified And Emerging Mycotoxins

Valentina Scarpino, Andrea Borio, Amedeo Reyneri, Massimo Blandino

Dip. di Scienze Agrarie, Forestali e Alimentari (DISAFA), Univ. Torino, IT, valentina.scarpino@unito.it

Introduction

Wheat ears could be affected by several fungal diseases, among which *Fusarium* Head Blight (FHB) is the most widespread, and causes total or partial premature ear senescence and consequently reduces both crop yields and grain quality. *Fusarium graminearum* and *Fusarium culmorum* are the most important FHB agents, and are the main causes of the production and the accumulation of type-B trichothecene deoxynivalenol (DON), which is the mycotoxin most present on wheat among those subjected to EU legislation (Champeil et al., 2004). However, DON is just one of the possible fungal metabolites produced by *Fusarium graminearum* and *Fusarium culmorum*, and the other fungal metabolites that co-occur together with DON in cereals are commonly enclosed in the large groups of mycotoxins called “emerging” and “modified” mycotoxins. The objective of this study was to compare 5 different durum wheat cultivars selected for the different FHB susceptibility evaluating their quality by the quantification of DON, “emerging” and “modified” mycotoxins.

Materials and Methods

The field experiments were carried out during 3 growing season: 2015-2016, 2016-2017, 2017-2018 in the site of Cigliano (45° 18' N, 8° 01' E; altitude of 237 m). For each growing season the comparison of 5 Syngenta varieties (Saragolla, Fuego, Odisseo, Secolo and SY Cysco) were carried out under natural inoculation conditions using a completely randomized block design with three replicates, with elementary plots of 11 m². The harvested grains were mixed thoroughly, and 2 kg grain samples were taken from each plot, milled and an aliquot of 5 g was analyzed to quantify the mycotoxin content, through a multi-mycotoxin HPLC-ESI-TQ-MS/MS method (Scarpino et al., 2019).

Results

In all the analysed samples, in addition to DON and zearalenone (ZEA), both subjected to EU legislation, were also detected 7 “emerging” and modified mycotoxins: 3-acetyldeoxynivalenol (3-ADON) deoxynivalenol-3-glucoside (DON-3-G), enniatins (ENN A, A₁, B and B₁) and moniliformin (MON). In the following Table have been reported only the contamination values of the overall DON (DON TOT = sum of DON, 3-ADON, DON-3-G) and enniatin (ENN TOT = sum of ENN A, A₁, B and B₁) forms. On average, the amount of the different DON forms varied depending on the variety FHB susceptibility and environmental conditions of the growing season, but always ranges from 75 to 90 % for DON, from 6 to 13% for DON-3-G and from 4 to 12% for 3-ADON (Table 1). The variety with the highest percentage of the modified forms of DON was Sy Cysco, followed by Fuego. However, the Sy Cysco was the most resistant variety and presented the lowest DON content, even if we referred to the total DON contamination. Similarly, for ENN forms, ENN B counts for the 70-80% of the ENN TOT, ENN B₁ for 15-27%, ENN A₁ for 3-5% and ENN A is only present in traces. The growing season that presented the highest DON (for all the forms) contamination was the 2017-2018 in which abundant rainfall have been recorded during the flowering stage; followed by the 2015-2016 growing season and lastly by 2016-2017 growing season. Conversely, for ENN (all the forms) and for MON the growing season with the highest level of contamination was the 2015-2016 growing season. As far as the variety FHB susceptibility and mycotoxin contamination is concerned, Saragolla was the most susceptible variety to FHB and contamination by all the detected mycotoxins, while Sy Cysco the most resistant recording the lowest

contamination level for all the fungal metabolites. On the other hand, Fuego, Odisseo and Secolo varieties showed to be intermediate as regards FHB susceptibility and mycotoxin content.

Table 1. Mycotoxin contamination in durum wheat varieties during 3 growing seasons.

Year	Variety	DON TOT		ENN TOT		MON	
		T	N (µg/kg)	T	N (µg/kg)	T	N (µg/kg)
2016	Saragolla	9.2 a	10121	8.3 a	4014	6.6 a	747
	Fuego	8.6 b	5342	6.8 b	921	5.9 b	355
	Odisseo	8.4 b	4408	6.9 b	956	5.9 b	359
	Secolo	8.5 b	4978	6.8 b	889	5.8 b	323
	SYCysco	7.7 c	2248	6.3 c	560	5.6 b	281
	<i>p</i> -value	< 0.001		< 0.001		< 0.001	
	sem ^a	1.0		1.4		0.7	
2017	Saragolla	8.0 a	3001	5.1 a	174	5.0 a	143
	Fuego	6.9 c	983	4.5 b	93	4.7 ab	107
	Odisseo	7.6 b	1991	4.4 b	85	4.7 b	104
	Secolo	7.3 b	1548	4.5 b	92	4.7 ab	106
	SYCysco	5.9 d	366	4.8 ab	115	3.9 c	50
	<i>p</i> -value	< 0.001		0.004		< 0.001	
	sem ^a	1.6		0.5		0.7	
2018	Saragolla	9.7 a	16911	6.4 a	625	5.7 a	297
	Fuego	9.2 b	9732	6.3 a	538	5.6 a	282
	Odisseo	9.2 b	9872	5.9 a	371	5.3 a	218
	Secolo	9.3 b	11164	6.1 a	492	5.2 a	187
	SYCysco	8.8 c	6579	5.9 a	372	5.1 a	165
	<i>p</i> -value	< 0.001		0.284		0.120	
	sem ^a	0.6		0.4		0.5	

The reported mycotoxin contamination means are transformed [T; $y' = \ln(x + 1)$] and not transformed (N) values.

^asem: standard error of the mean.

Conclusions

In environments prone to FHB and DON contamination, the results underline that the choice of the variety is fundamental to ensure the grain quality and food safety. Moreover, data collected highlight that in order to identify the most suitable genotypes for the supply chain is necessary to verify the health aspects also with regard to the “emerging” and “modified” mycotoxins, in addition to the production parameters. Presently, the Sy Cysco variety shows a greater tolerance to FHB and lower levels of all the mycotoxin contaminations, including the modified mycotoxins of DON and the emerging fungal metabolites, than the other tested varieties.

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