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CULTIVATED LANDRACES WHEAT, OLD CROPS BUT PROMISING FUTURE FOR RESISTANCE TO BIOTIC STRESSES: THE SPECIFIC CASE OF A FUNGUS DISEASE, FHB (FUSARIUM HEAD BLIGHT). A REVIEW.

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Abstract: The present review attempts to synthesize the information available on landraces wheat, cultivated in organic farming, especially their resistance qualities to fungi diseases and FHB (Fusarium Head Blight) in particular, a widespread and destructive disease of grain cereals. Infection can also cause a reduction in grain quality through the synthesis of mycotoxins. Wheat landraces have been shown to be valuable sources of resistance to pathogens and there is more to be gained from such sources. However, changes are needed to promote the exploitation of diversity in landraces and encourage their use.

Introduction:

Modern agriculture and conventional breeding have resulted in the loss of genetic diversity in cereals. Increasingly landraces are being replaced by modern cultivars, which are less resilient to biotic (pests and diseases) and abiotic stresses. Wheat landraces are composed of traditional crop varieties developed by farmers through years of natural and human selection, are adapted to local environmental conditions and management practices and are maintained by farmers (Jaradat, 2013).

Landraces have very rich and complex ancestry representing variation in response to many diverse stresses and have been shown to be valuable sources of resistance to pathogens. There is also potential, largely unrealised, for resistance to biotic pressures and various abiotic stresses as climatic change (Newton et al., 2010).

The present review aims to synthesize the articles available on these species, their agronomic qualities (which can indirectly influence health crop status) and their resistance especially to fungi diseases and FHB (Fusarium Head Blight) in particular. FHB caused by a range of fungi of the group *Fusarium* spp., is a severe disease of wheat almost worldwide, causing significant yield losses and the synthesis of mycotoxins, in particular the trichothecene deoxynivalenol (DON) which can affect both humans and animals.

Material and methods: Diseases resistance of cereal landraces and to Fusarium Head Blight (FHB) particularly

There are few but consensual studies of landraces diseases tolerance: resistance has been found for Septoria leaf blotch, powdery mildew, rust diseases and Fusarium Head Blight (FHB) (Newton et al., 2010; Zaharieva and Monneveux, 2014). The immunity of einkorn, for example, was first reported by Biffen (1907) who recommended its utilization to create new cultivated varieties with improved resistance.

1-Landraces cereal less attacked by FHB in organic agriculture

Organic farming combines different agricultural practices less risky for diseases and FHB in particular:

- The presence of tillage that can bury the residues (the direct drilling system generally results in the highest levels of contamination of Fusarium and mycotoxins) (Champeil et al., 2003). So, the tillage practices in relation to the previous crop residue management differentially affect the incidence and severity of FHB: wheat grown after soybeans reduced FHB compared with wheat grown after maize or wheat (Dill-Macky and Jones, 2000).

- Several studies have reported increased Fusarium infestation and mycotoxin contamination in cereals associated with an increased level of nitrogen fertilisation, and that mineral fertilisers seem to stimulate Fusarium infestation and infection more than organic fertilisers (Heier et al, 2005; Bernhof et al., 2010).
- The application of fungicides against leaf diseases on wheat could favour the spread of FHB, as the saprophytic microflora on grains is suppressed and Fusaria find a competitive advantage (Lazzaro et al., 2015)
- Organic farming works with a wider diversity of crops.

There is no clear-cut trend in favour of organic cereals or in favour of their conventional counterparts. Conventional products seem to be favoured due to protection with chemical fungicides. But it seems that organic products are also favoured because of agronomic practices very efficient to reduce contamination (Tangni et al., 2013).

2- Old wheat less attacked by FHB than modern wheat

There is not enough articles and information on the resistance of old varieties to FHB while the resistance of wheat genetic resources to FHB is an important question as it could assure the safety of food products.

- Some studies found significantly higher FHB intensity in shorter plants than in higher plants like landraces wheats. It was speculated that this difference in disease resistance was related to disease escape, where taller cultivars have ears held at greater distances from the primary sources of inoculum such as infected crop debris (Hilton et al., 1999). For Mesterhazy (1995), the optimal plant structure against FHB involves: plant height about 90-100cm, awless and the distance between flag leaf and ear should be at least 15cm and the head should not be too dense.

-Apart from active plant defense (inheritance of FHB resistance would have a quantitatively controlled character by a various number of genes), passive resistance mechanisms may also play a significant role (e.g. plant height, presence or absence of awns and ear morphology). These traits may contribute to passive resistance under natural infection. Grain hulling could be one of the factors that condition passive resistance to infections because hard husks that tightly cling to the kernel may pose an effective barrier for mycelial filaments (Buerstmayr et al., 2003; Suchowilska, 2010). In parallel, low proportion of DON was detected in the hulled wheat varieties (einkorn, emmer wheat, spelt wheat). Resistance to FHB in wheat is controlled by polygenes that usually have small effects and are vulnerable to environmental influences (Buerstmayr et al., 2003; Suchowilska, 2010) . For example, several Chinese landraces have been reported to show a high level of resistance (Tao Li et al., 2016)

But to date there is not enough information on the resistance of old wheat to FHB, as the range of varieties and species is very wide (Konvalina et al., 2011)

Nevertheless, DON contamination appears to be influenced by wheat species, with spring spelt varieties having the lowest rates (Konvalina et al., 2011; Suchowilska, 2010).

Discussion: Conclusion

Lower levels of *Fusarium* mycotoxin contamination of organically produced cereals compared with conventionally produced have been reported, but the causes of these differences are not well understood but dependent on both geographic location and agricultural practices

The use of old wheats as a reservoir of genes for improving bread and durum wheat has been quite successful and still represents an important hope. The traits of resistance to fungus disease like FHB as well as tolerance to heat and drought present could be of great interest in the context of climate change and evolution of agriculture.

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