

Molecular approaches for identifying sources of resistance to Fusarium wilt and Head Blight as the main pathogen causing wheat quality degradation

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SUMMARY

In recent years, the prevalence of Fusarium wilt (*Fusarium* sp.), which development is favored by dry and hot environments, has continued to increase in the context of climate change. It tends to become a serious problem on durum wheat (*Triticum turgidum*) which is particularly sensitive to it. Thus, it induces a loss in yield and affects the quality by producing mycotoxins mainly deoxynivalenol (DON). The use of resistant varieties remains the most promising solution and the most respectful of the environment. In Morocco, there is so far little or no information on resistance to Fusarium wilt in germplasm grown in Morocco. To this end, a collection of durum wheat genotypes was evaluated for resistance to root and crown rot at the seedling stage then Head Blight until adult stage. Sources of resistance were identified using "SSRs" molecular markers. Resistant, moderately resistant, moderately susceptible, susceptible and very susceptible genotypes were identified. Fhb1 and Fhb5 genes are shown to be the most represented respectively by (53%) and (17%). The pathological study of Fusarium wilt populations collected from different wheat growing areas in Morocco has identified the Genus *Fusarium* in the roots and collar of infected plants. The molecular study made it possible to characterize five *Fusarium* species in the wheat fields surveyed. *Fusarium culmorum* was noted as the dominant species with a percentage of 60%; while *Fusarium. equiseti*; *Fusarium graminearum*; *Fusarium sambucinum* and *Fusarium avenaceum* were present respectively with percentages of 13%, 7%, 3% and 1%.

Key words: Durum wheat, *Fusarium* sp, molecular marker, SSRs

MATERIALS AND METHODS

Plant material was collected during the survey of 2020-2021 from wheat fields localized in the main Moroccan cereal regions

73 *Fusarium* isolates were purified from plant exhibiting the symptoms of *Fusarium* at the roots, crown and head;

Morphological analysis were concerning study of appearance, color and speed growth of colony;

Microscopic analysis were used for fungal isolates identification

Pathological evaluation of durum population under controlled conditions

102 genotypes were evaluated under controlled conditions with virulent isolates;

Severity and dry weight of the plant assessment was done for seedlings stages;

Molecular analysis of fungal population using specific markers linked to each species;

SSR molecular marker were used for screening of wheat collection and identification of resistant genes



RESULTS

Fusarium sp. characterization

- Morphological and microscopic analysis classified the isolates among fusarium species ;
- Molecular analysis allowed isolates to be classified into 5 species for all cereal regions with different abundance

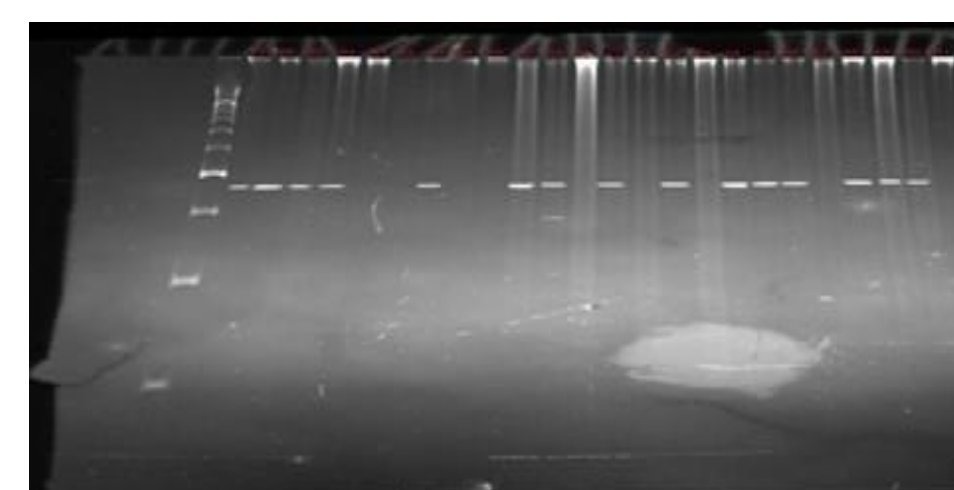


Fig 1: Electrophoretic profile of DNA amplified by primer 175F / 430R

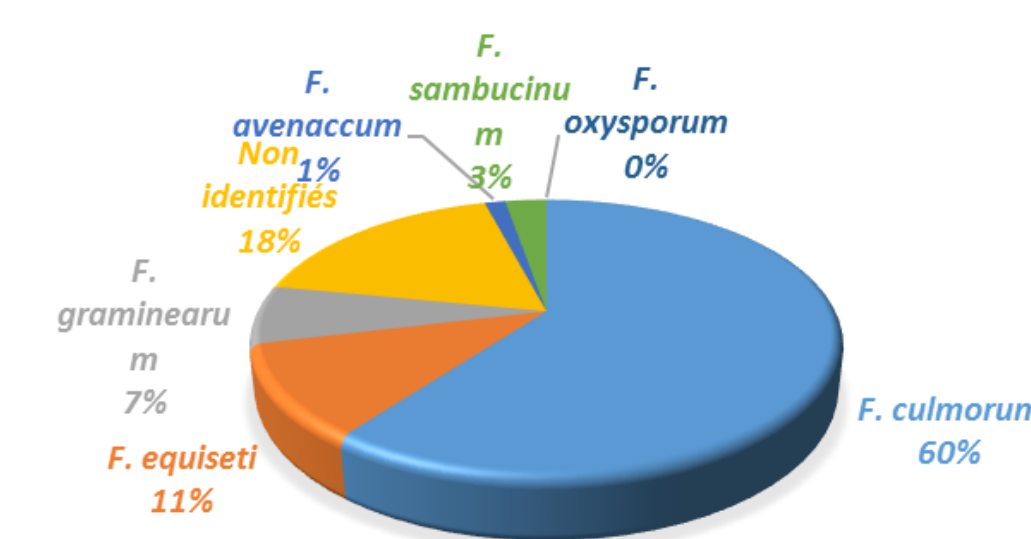
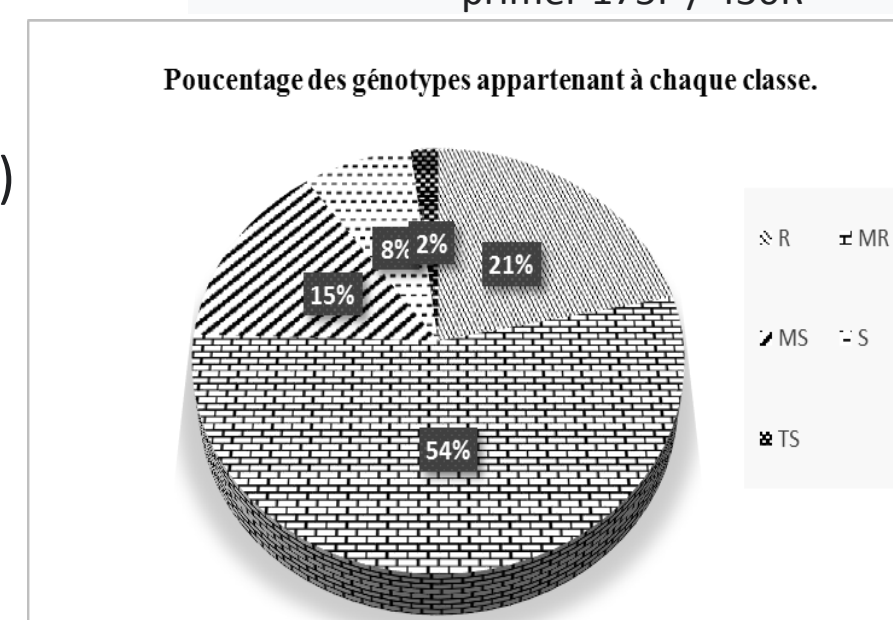


Fig 2: Graphical representation of the percentage of *Fusarium* species identified

Pathological evaluation of durum population under controlled conditions

- The plants of each genotype were classified according to severity on 5 classes : R (22%), MR(54%), MS (15%), S (8%), VS (2%) (fig 3);
- For dry weight, wheat population were grouped on 3 homogenous groups : high weight, medium weight and low weight (table 1);

(fig 3)



(Tab 1)

Genotype number	PS average	Class
20	PS > 300 mg	High weight
54	200 < PS <= 300	Medium weight
28	73 < PS <= 200	Low weight

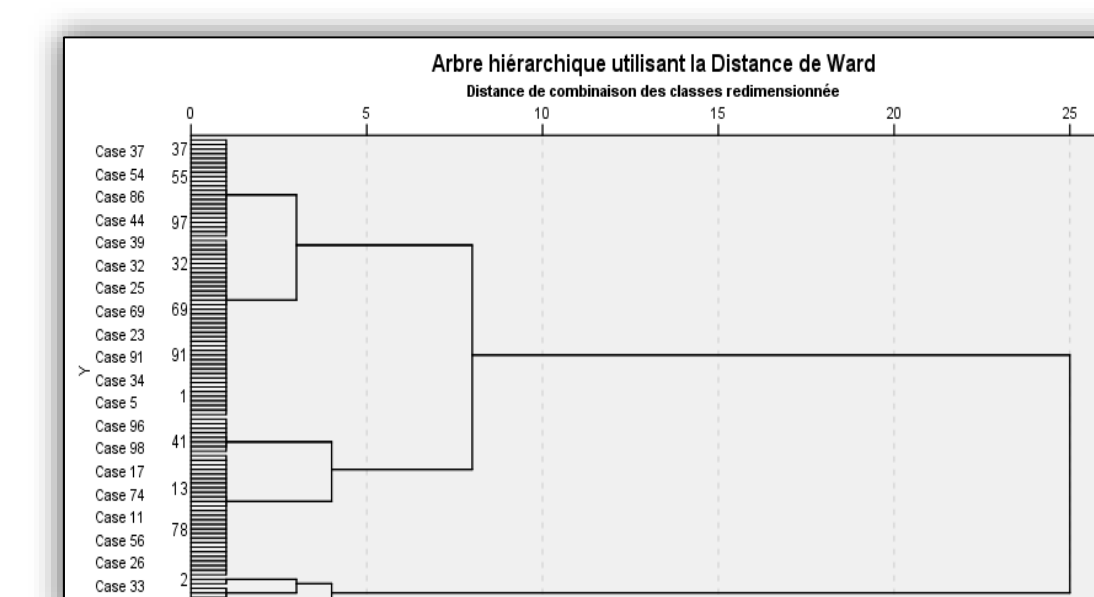
Linear regression between the 2 variables studied (PS and IS)

- The theoretical statistical model reveals that 4.2% of the variation of dry weight of plant is explained by the disease with a regression coefficient equal to -0.79 (table 2).
- Hierarchical classification allows genotypes to be classified into 3 majors groups (fig 4).

Tab 2

Class	Number of genotypes	Caracteristiques	
		severity index	Dry weight
Class 1	61	28,3 %	265,4 mg
Class 2	34	47,6 %	223,3 mg
Class 3	5	77,8 %	112,2 mg

Fig 4;



Molecular evaluation of durum population

Molecular analysis was performed :

- For Fhb1 by primers (Xgwm389, Xgwm493) (fig 5);
- For Fhb5 (3B) by primer Xgwm304;
- Other markers will be tested for most traits;

Analysis allow us to obtain specific profiles for each primer;

The results obtained with the primers for Fhb1 and Fhb5 made it possible to classify the genotypes according to the number of genes, (fig 6).

The genotypes which have the Fhb1 and Fhb5 genes are the most interesting as sources of genes for resistance to Fusarium wilt

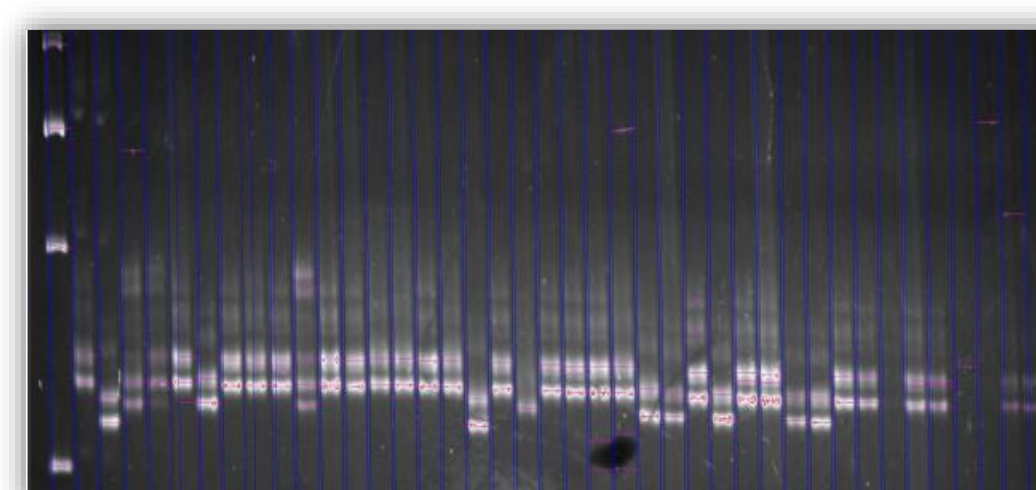


Fig 5: Profiles generated by the Wgwm389 primer of some genotypes

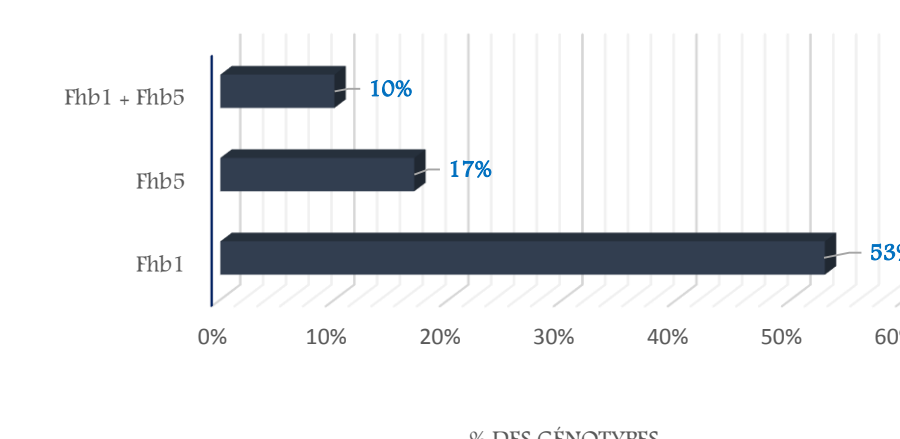


Fig 6: Richness of the collection studied in fusarium resistance genes.

CONCLUSION

- Five species of *Fusarium* were identified in Morocco; *Fusarium culmorum* is more dominated
- Durum genotypes are more resistant to *Fusarium*
- Resistant genes *Fhb1* are dominated in durum genotypes