WHEAT POWDERY MILDEW PSEUDORESISTANCE PRODUCED BY *BLUMERIA GRAMINIS* F. SP. TRITICI THROUGH PREEXISTENT AND POSTINFECTION STRUCTURAL MECHANISM

PSEUDOREZISTENȚA GRÂULUI LA FĂINAREA PRODUSĂ DE CIUPERCA *BLUMERIA GRAMINIS* F. SP. TRITICI PRIN MECANISME STRUCTURALE PREEXISTENTE ŞI POSTINFECȚIONALE

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Abstract: *Biotrophic fungus Blumeria graminis in wheat can produce quantitative and qualitative loses. In these condition prevention and control of this parasite fungus can be realised through the application of the modern concept of plant protection "Integrated plant protection". This complex system provides constant qualitative and quantitative yields, and the non pollutant subsystem that is also economically is "genetic control", respectively the genetic resistance of the wheat plants. Wheat varieties are avoiding the incidence of powdery mildew, or are diminishing the fungus aggressiveness and virulence through structural and genetic mechanisms. Structural mechanisms are imprinting a false resistance of a pseudoresistance, or non-specific that is provided by the presence in wheat varieties by pre-existent structures as is the cuticula, epidermal cells membrane and his impregnation of it with different organic substances, ectoderm and pilosity and "de novo" postinfectional structures as are apresoria – MA and haustorial MAT-EH. In fact the glycoproteins are produced by the wheat varieties genes. These structures are determined by pseudoresistance being in fact the defending responses of the wheat varieties (Dor, Falnic, Gruia, Gloria and Bercsy studied during 2003-2005) to the action of evolutionary and conservative genome of the fungus – PAMPs, and also by the activity of resistance genes Pm (powdery mildew).*

Rezumat: *Ciuperca biotrofă Blumeria graminis la grâu, poate provoca pierderi cantitative şi calitative de recoltă. În astfel de condiții, prevenirea sau eradicarea ciupercii parazite se poate realiza prin aplicarea conceptului modern de protecția plantelor şi anume ,,Producția integrată". Din acest sistem complex, ce asigură producții cantitative şi calitative constante, subsistemul (sau veriga) extrem de economic şi non-poluant este ,,Controlul genetic", respectiv rezistența genetică a plantelor de grâu. Soiurile de grâu evită îmbolnăvirea la făinare sau atenuează agresivitatea şi virulența ciupercii prin mecanisme structurale şi genetice. Mecanismele structurale imprimă o rezistență falsă sau pseudorezistență, sau nespecifică, care este asigurată de prezența în soiurile de grâu de structuri preexistente, cum sunt cuticula, membrana celulelor epidermice şi impregnarea acesteia cu diferite substanțe organice, ectodesmele şi pubescența cât şi de structuri postinfecționale, ,,de novo" ca matrițele apresoriale - MA şi cele haustoriale MAT-EH, de fapt glicoproteine produse de genele soiurilor de grâu. Structurile amintite determinate de gene pseudorezistente, sunt de fapt răspunsurile de apărare a soiurilor de grâu (Dor, Falnic, Gruia, Gloria şi Bercsy observate în perioada 2003-2005) la acțiunea genomului evolutiv şi conservativ al ciupercii – PAMPs, dar şi de activitate a genelor de rezistență Pm (powdery mildew).*

Key words: *powdery mildew, wheat, pseudoresistance, genes, preexistent and postinfection structures.*
Cuvinte cheie: *pseudorezistență, rezistența structurală, ectodesme, matrițe apresoriale, matrițe haustoriale, Blumeria graminis, făinare, control genetic.*

INTRODUCTION

Plants are avoiding the incidence of disease and attenuate the pathogens aggresivity and virulence with the help of two categories of mechanisms: structural and genetic.

In the first case is provided a pseudoresistance (false resistance, physical appearance reaction, passive and indirect) through pre-existent mechanic barriers (preinfectional) or postinfectional, that are stopping the entrance and development of plant pathogens. This kind of defence is coordinated through genes, but not through resistance genes, and their expression have an adaptation role, and if they are acting as defensive role is due only through chance (E. J. PARLEVLIET, J. C. ZADOCKS, 1977; N. CEAPOIU, FLOARE NEGULESCU, 1983; EUGENIA ELIADE, 1990; S. HIPPE SANWALD *et al*., 1994; S. E. PERFECT, 2001; OTILIA COTUNA, GH. POPESCU, 2004; GH. POPESCU, 2005; OTILIA COTUNA, 2007).

In the second case the coordination of the defence is realised by resistance genes that provides the real resistance or euresistance (R. PANSTRUGA, P. S. LEFERT, 2002; ASAI *et al*., 2002). Pseudoresistance and euresistance express the genetic potential of the interaction among plant-host-parasite or coevolutionary pathologic system (GH. POPESCU, 2005). In this way, the interaction of pseudoresistance from inside of the *Blumeria graminis-Triticum aestivum* pathologic system is provided by the presence of "de novo" pre-existent and postinfectiona; structures .

MATERIAL AND METHOD

The observations were realised on a sort of 27 winter wheat varieties (Dor, Falnic, Gruia, Gloria, Bercsy, Ardeal, Fundulea 4, Holda, Dropia, Renan, Flamura 85, Turda 95, Turda 2000, Bezostaia, Partizanka, G. K. Othalom, G. K. Göbe, Arieşan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Farmec, Izvor, Ciprian) cultivated in a comparative crop from ICDA – Fundulea. These wheat varieties were cultivated at SCDA Lovrin during 2003-2005, on a humid cambic chernozem. Fungus virulence is appreciated on a 0-9 scale transformed in percentage (1 – 10%; 9.0 – 100%).

RESULTS AND DISCUSSIONS

Pre-existent or preinfectional structures can form on the wheat plants surface and is stopping the germination of *Blumeria graminis* conidia and ascospores to the action on wheat powdery mildew are cuticula , epidermal cells membrane, impregnation of epidermal cells membrane with organic compounds highly polymerised, foliar hairs (pubescence) and the structures named ectodesma that are disappearing during anamorphic sporogenesis (*GANIC et al.*, 1979 – cited by EUGENIA ELIADE, 1990; N. CEAPOIU, FLOARE NEGULESCU, 1983; EUGENIA ELIADE, 1990; GH. POPESCU, 1998; OTILIA COTUNA, 2007). The cuticle and other polymers of the epidermal cells are not always physical barriers for *Erysiphales* fungi that are producing the powdery mildews in plants. In conclusion, the pre-existent structures of the plants that provide wheat pseudoresistance against powdery mildew are determined by genes, but not by resistance genes, these being the result of the adaptation. Concerning the postinfectional structures or "de novo" in literature are some examples that shows these structures. As an example, *Blumeria graminis f. spec. tritici* elaborating infectious structures, first the apresoria (K. MENDGEN *et al*., 1988; M. C. HEATH, 1995; S. E. PERFECT, R. J. GREEN, 2001) and then the haustoria (J. M. MANNERS, J. L. GAY, 1983). Mentioned structures are protected or covered in some matrix – MA (apresoria) and MAT-EH (haustoria) synthesised by wheat, but not by epidermal cell where the fungus is entering, this thing being confirmed by the lack of ATP-asis activity at the level of this cell that provides the energy for synthesis (M. C. HEATH, 1995; P. T. N. SPENCER-PHILLIPS, J. L. GAY, 1981; D. SKALMERA, 1997).

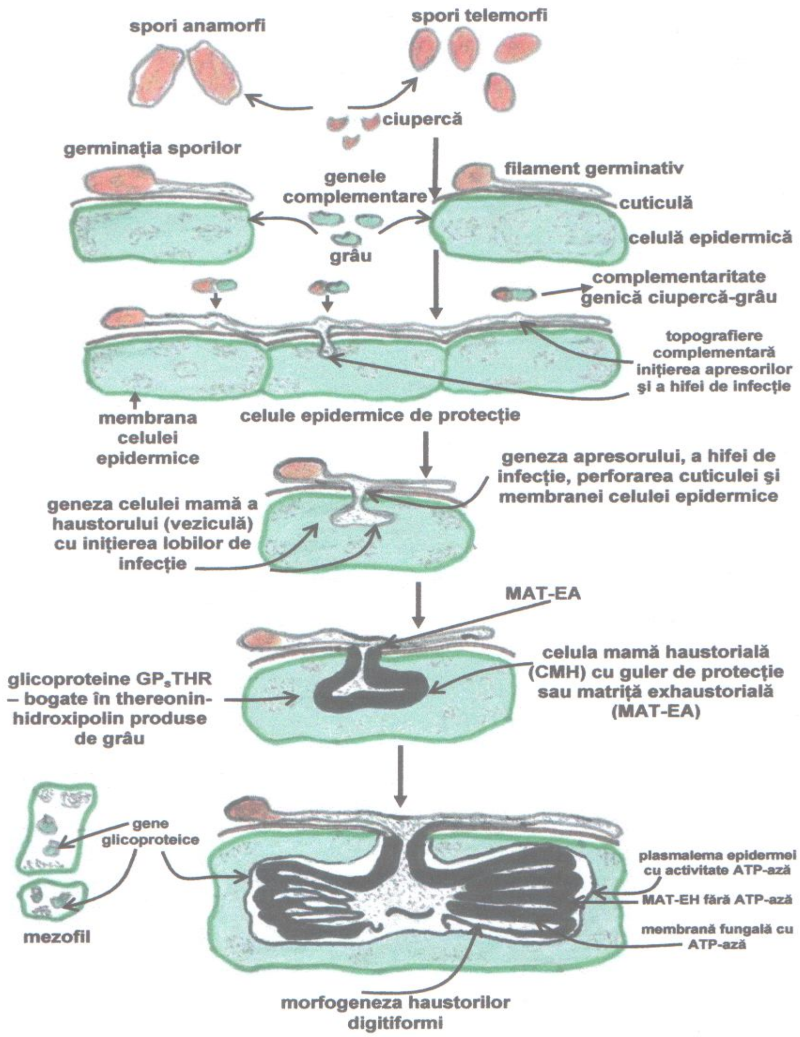

Fig. 1. Infectious structures morphogenesis (apresors and haustors) in *Blumeria graminis f. sp. tritici* (original)

MA and MAT-EH are formed from glycoprotein produced by genes and they where identified in *Erysiphales* fungi that are parasite on grain cereals and on peas – *Erysiphe pisi* (A. J. MACRIE *et al.*, 1993; S. HIPPE SANWALD *et al.*, 1994) and in *Colletotichum* fungi that are parasite on bean, soybean and clover (S. E. PERFECT, 2001). Cited matrixes that are presented in figure 1 are interpreted by S. HIPPE SANWALD *et al.* (1994) and S. E. PERFECT *et al.*, (1998, 1999, 2000, 2001) as barriers or "de novo" defence structures these being in fact the expression of some genes that in our interpretation are non-specific resistance genes and they can have the protection role and adapting role for both partners from coevolutionary pathologic system *Blumeria graminis – Triticum aestivum.*

Opaque papilla formed by epidermal cells of the cereal plants after ZEYEN *et al*., (1980), TOSA *et al*., (1984) cited by EUGENIA ELIADE (1990) have inhibitory role for secondary haustoria and are considered postinfectional structures.

CONCLUSIONS

An analysis of the molecular resistance of the cereals in comparison with evolutionary and conservative genome (PAMPs - pathogen associated molecular patterns) of *Blumeria graminis* fungus presented by R. PANSTRUGA *et* P. S. LEFERT (2002), and ASAI *et al*., (2002), are leading us to the next interpretation of the comportment of those 27 winter wheat varieties:

- the resistance of Dor, Falnic, Gruia, Gloria and Bercsy varieties is given by Pm (powdery mildew) specific resistance genes and by intense activity of pseudoresistant genes:

- average resistance of Ardeal, Fundulea 4, Holda, Dropia and Renan is coordinated by non-specific genes and by a medium activity of the pseudoresistant genes;

- sensitivity of Flamura 85, Turda 95, Turda 2000, Bezostaia, Partizanka, G. K. Othalom, G. K. Göbe, Arieşan, Lovrin 34, Alex, Romulus, Boema, Crina, Delabrad, Farmec, Izvor, Ciprian varieties is explained through the lack of germinator plasma of these two categories of genes.

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