ASSESSMENT OF *BLUMERIA GRAMINIS F.SP. TRITICI* ATTACK ON DIFFERENT ROMANIAN WINTER WHEAT VARIETIES

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Abstract:*Powdery mildew of wheat caused by the pathogen Blumeria graminis f.sp. tritici is one of the most common diseases of wheat which occurs on temperate area. Previous findings emphasized that according with severity and time of attack Blumeria graminis f.sp. tritici reduces supply of photosynthesis on leaves, decreases leaf assimilation index, negatively affects yield components and finally the grain yield. The pathogen attack was evaluated on twenty-five winter wheat varieties under natural field conditions during the year 2010-2011. The experimental design was a randomized block design with three replications. Disease rating was visually recorded using the double-digit scale (00-99) on the growth stage 9-ligule of flag leaf just visible (Freekes scale).There were also calculated for each wheat genotype the attack frequency (F%), the attack severity (I%) and attack degree (AD%).The attack degree value ranged between 2,8% for Dor variety and 12,4% for Gruia variety. Among the most affected varieties were also Simnic 30, Delabrad, Noroc, Magistral, while a better assessment to the pathogen attack was recorded by Crina, Romulus and Dor varieties. According with crop stage and pathogen attack severity, the extend of yield losses can be predicted mathematically and it was observed that during 2010-2011 conditions the occurrence of the attack on the stage ligule of flag leaf just visible didn't influence significantly the yields, aspect emphasized also by the negative correlation coefficient between attack degree and yield level (r=-0,3258).The highest yields were recorded by the varieties Trivale (6277 kg/ha) and Europa (6230 kg/ha), while the lowest yields were recorded by Noroc (4187 kg/ha) and Briana (4029 kg/ha). Despite Gruia variety recorded the highest attack degree on the conditions of 2010-2011 year, its yield was 6027 kg/ha leading to the conclusion that it could has tolerance to that attack of Blumeria graminis f.sp. tritici, but this needs further investigation on the higher infection pressure levels on the years more favorable for this pathogen development.*

Key words: *pathogen attack, Blumeria graminis f.sp. tritici, powdery mildew, yield, winter wheat*

INTRODUCTION

Powdery mildew of wheat caused by the pathogen *Blumeria graminis* (DC) E.O. Speer f.sp. *tritici* Marchal (*Erysiphe graminis* f.sp.*tritici*) is one of the most common diseases of wheat which occurs on temperate area, causing significant economically decreases on winter wheat. Yield losses caused by powdery mildew on wheat ranging up to 34% have been reported on susceptible cultivars on high severity levels of the epidemics (Johnson et al. 1979) and even can reach higher levels (ZHANG ET AL.2008, LI ET AL.2011, ALAM ET AL.2013). Previous findings emphasized that according with severity and time of attack *Blumeria graminis* f.sp. *tritici* reduces supply of photosynthesis on leaves, decreases leaf assimilation index, negatively affects yield components and finally the grain yield (BOWEN ET AL. 1991, HENRY AND KETTLEWELL 1996, SAMOBOR ET AL. 2005, 2006). Seed treatment may not be effective for all season control, while foliar fungicides could not be economically feasible (LEATH AND BOWEN 1989, LIPPS AND MADDEN 1989). Thus, the most effective control method against this pathogen has been focused on the use of race-specific resistance genes, but generally of short-lasting durability (MEIDANER et al. 1993). Virulence frequencies are highly

influenced by the resistance genes carried by cultivars grown in a particular area (PERSAUD et al. 1994). The objective of this study was to confirm the validity of the cultivar choice as susceptibility control measure on the same growing condition factors and growing plants stage.

MATERIAL AND METHODS

Field plots of winter wheat were established during 2010-2011 growing season at the Agriculture Research and Development Station Simnic-Craiova in the Breeding and Plant Protection Laboratory on brown reddish soil (pH 5,6; humus 1,8%). Twenty-five winter wheat cultivars with different resistance levels were evaluated in natural conditions for their response to *Blumeria graminis* f.sp. *tritici* attack. Plants received a balanced starter fertilization preplanting with 40 kg N/ha and 40 kg P_2O_5 kg/ha basal applied and top-dressed with 60 kg N/ha on early spring (March). Seedling was done on October 2010 using a seed rate of 550 grains/m^2. The experimental design was a randomized complete block design with three replications. Disease rating was visually recorded as soon as the first symptoms appearance on the leaves using the double-digit scale (00-99) on the growth stage 9-ligule of flag leaf just visible (Freekes scale). The first digit (D_1) indicated vertical disease progress on the plant and the second digit (D_2) refers to severity measured as diseased leaf area. For each score, disease severity percentage was calculated based on the following formula (SHARMA AND DUVEILLER, 2007):

$$\% \text{ severity} = (D_1/9)\ (D_2/9)\ 100$$

Growth stages of plants were recorded according to the Freekes scale (LARGE, 1954). There were also calculated for each wheat genotype the attack frequency (F%), the attack severity (I%) and attack degree (AD%). For each score, percent disease incidence (I) was estimated based on the formula: $I\% = \frac{nx100}{N}$, where *n* is the number of diseased plants, *N* is plants total number/ m^2. The data were used to calculate the attack degree (AD) following formula: AD% =(S% x I %) /100 (SAVESCU et al., 1969).

The correlation coefficient (r) between pathogen attack degree and yield level was also calculated according with the following formula (PEARSON AND HARTLEY, 1970):

$$r = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

The control was Dor, a genotype who did display the lowest symptoms. Means for yield and attack degree were separated using least significance differences (LSD) at the 1% to 5% level of probability. Statistical analysis involved analysis of variance procedure (SAULESCU, 1967).

RESULTS AND DISCUSSIONS

The climatically conditions and resistance levels of wheat varieties are the most important factors for successful colonization of *Blumeria graminis* f.sp. *tritici* (COSTAMILAN, 2005, LUCK et al.2011). Infections can take place between 5°C and 30°C, but cold, humid weather with temperatures between 15°C -20°C are the most favorable for rapid fungus spread, which can complete a repeating cycle in 7-10 days resulting in development of new virulent powdery mildew races (PIARULLI et al.2012). On the evaluated period, wheat growing season 2010-2011, the climatically conditions were relatively favorable for *Blumeria graminis* f.sp. *tritici* development, but are necessary further investigation of the behavior of the varieties

mixture on both natural and artificial infections. Because of the continuous mutation of wheat powdery mildew fungus resulting in production of more virulent strains, the development and selection of wheat cultivars resistant or tolerant to the powdery mildew pathogens become an effective control method used by scientists (MWALE et al.2014).

Analysis of variance performed with every genotype on the same growing factors and climatically conditions emphasized that the mildew reaction of adult plants was different. The results suggested that in this pathosystem climatically conditions may be an important determinant of infection levels in a given mixture tend more toward those of the resistant or the susceptible component. The different levels of pathogen aggressiveness on susceptible cultivars as compared with less susceptible ones can be explained by differences in variances in aggressiveness when the pathogen is on different host genotypes. Thus, the attack degree ranged between 2.8% (Dor variety) and 12.4% (Gruia variety). Among the most affected varieties were also Simnic 30, Delabrad, Noroc, Magistral, while a better assessment to the pathogen attack was recorded by Crina, Romulus and Dor varieties (Fig.1).

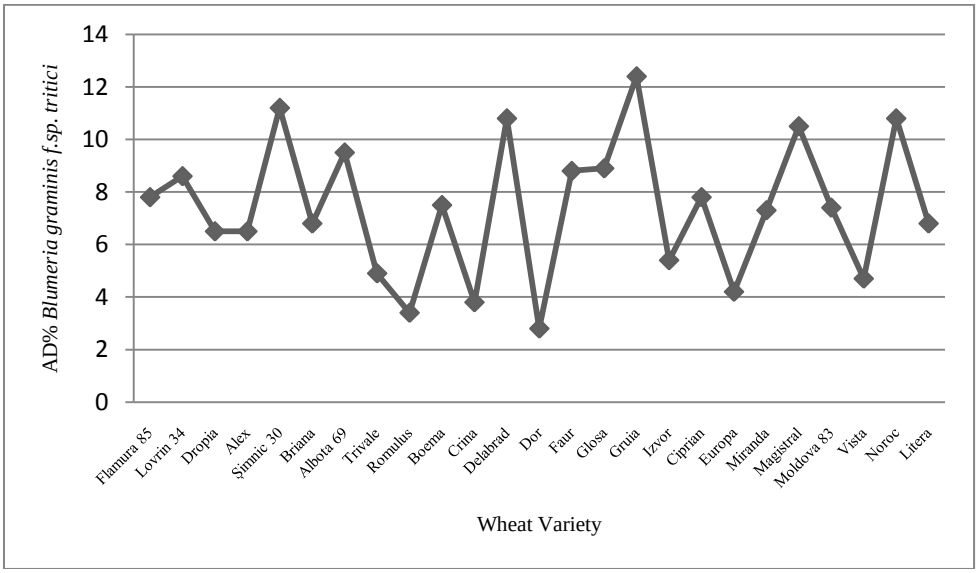

Fig 1. The values of *Blumeria graminis* f.sp. *tritici* attack degree (%) on different wheat genotypes during wheat growing season 2010-2011

The highest yields were recorded by the varieties Trivale (6277 kg/ha) and Europa (6230 kg/ha), while the lowest yields were recorded by Noroc (4187 kg/ha) and Briana (4029 kg/ha) (Fig.2). Comparatively with the control (Dor variety) the Trivale and Europa varieties which recorded low attack degrees recorded also very significant yield increases, while Noroc and Briana, which were more affected by *Blumeria graminis* f.sp. *tritici* attack, recorded a very significant yield decreases. Despite Gruia variety recorded the highest attack degree on the conditions of 2010-2011 year, its yield was 6027 kg/ha leading to the conclusion that it could has tolerance to that attack of *Blumeria graminis* f.sp. *tritici*, but this needs further investigation on the higher infection pressure levels on the years more favorable for this pathogen development.

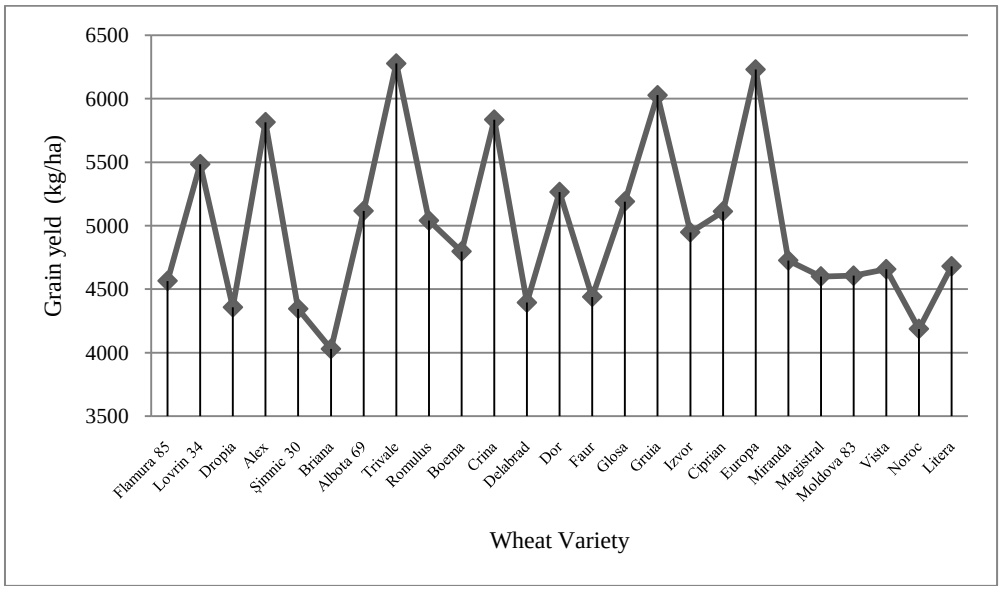

Fig.2 The yield values recorded by wheat varieties affected
by *Blumeria graminis f.sp. tritici* during wheat growing season 2010-2011

According with crop stage and pathogen attack severity, the extend of yield losses can be predicted mathematically and it was observed that during 2010-2011 conditions the occurrence of the attack on the stage ligule of flag leaf just visible didn't influence significantly the yields, aspect emphasized also by the negative correlation coefficient between attack degree and yield level (r=-0,3258) (Fig.3).

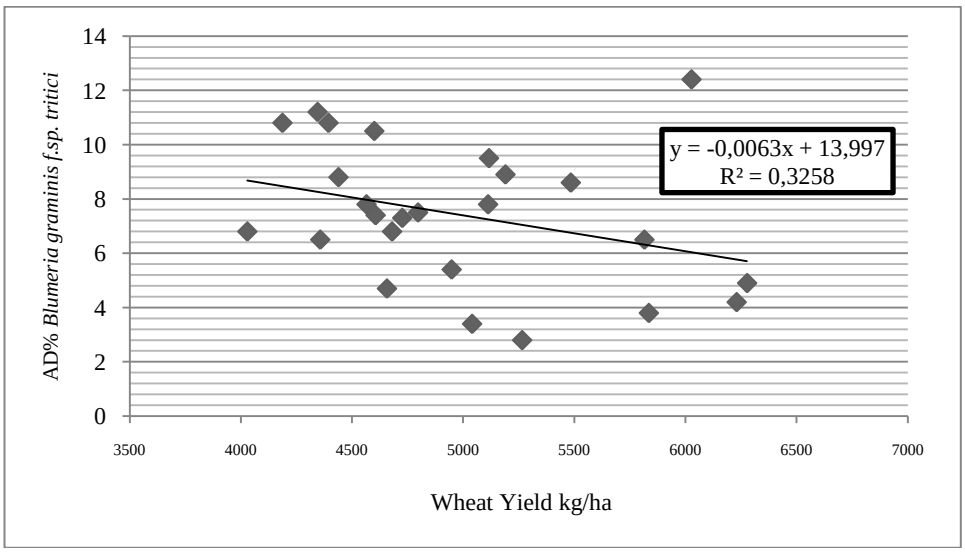

Fig.3. Relationship between *Blumeria graminis f.sp. tritici* attack degree
and yield level for wheat varieties gown during 2010-2011

Previous finding emphasized that mixtures are more useful under some epidemiological conditions than under others, and experimental methodology, especially problems of scale, may be crucial in evaluating the potential efficacy of mixtures on disease (MUNDT 2002). Agronomic and marketing considerations must be carefully evaluated when implementing mixture approaches to crop management. Practical difficulties associated with mixtures have often been overestimated, however, and mixtures will likely play an increasingly important role as we develop more sustainable agricultural systems.

CONCLUSIONS

The cultivars mixture effect on successful colonization of *Blumeria graminis f.sp. tritici* appears variable and environmentally influenced. The different levels of pathogen aggressiveness on susceptible cultivars as compared with less susceptible ones were due to the differences in variances in aggressiveness when the pathogen is on different host genotypes. The most susceptible cultivars were Gruia, Simnic 30, Delabrad, Noroc, Magistral, while a better assessment to the pathogen attack was recorded by Crina, Romulus and Dor varieties. Despite Gruia variety recorded the highest attack degree on the conditions of 2010-2011 year, its yield was 6027 kg/ha leading to the conclusion that it could has tolerance to that attack of *Blumeria graminis* f.sp. *tritici*, but this needs further investigation on the higher infection pressure levels on the years more favorable for this pathogen development. During 2010-2011wheat growing season conditions the occurrence of the attack of *Blumeria graminis* f.sp. *tritici* on the stage ligule of flag leaf just visible didn't influence significantly the yields (correlation coefficient was low -0,3258). For a better selection of the varieties mixture control on the colonization of *Blumeria graminis* f.sp. *tritici* there are necessary further investigations under higher both natural and artificial infections.

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