

THE ABSTRACT OF PHD THESIS
RESEARCH REGARDING THE BEHAVIOUR TO PATHOGENS ATTACK OF A
SET OF WINTER WHEAT VARIETIES IN DIFFERENT TECHNOLOGICAL
CONDITIONS ON BROWN REDDISH SOIL TO ARDS SIMNIC

The diseases represent the main cause of wheat yield losses worldwide in all growing areas, caused by pathogens. Among these pathogens the fungus are considered the main cause of losses all over the world (Margaret Tuttle McGarth, 2004). The wheat crop is frequently related with pathogens attack, which can limit the varieties yielding capacity up to agro technical conditions. In favorable years the yield losses can ranged between 10-20%, sometimes with higher values or can be destroyed. In case of *Tilletia* species or *Fusarium* species attack the losses are quantitative and qualitative. A loss is high as well as the attack degree is high (Bărbulescu, 2000, 2001; Popov et al., 2003). Because of economical losses the wheat pathology include soil-borne pathogens, foliar pathogens and head pathogens.

The research about the influence of technological conditions to pathogens attack were in the researchers attention especially in the last time because the changes involved by new agriculture systems which preserve natural recourses and soil determined modifications in pathogens aggressively. Thus, an integrate management system for pathogens control must include technological measures beside chemical and biological ones.

The research presented in the present Phd thesis were focus to the comparative study of the autochthonous and foreign wheat varieties on brown reddish soil at ARDS Simnic in different technological systems (conventional with high nitrogen rate N100P40, conventional with low nitrogen rate N40P40), different sowing times (normal sowing time -16 oct. and delayed sowing time – 30 oct.) and different seed rates (550 germinal seeds /m² and 275 g.s./m²) with the goal to emphasized those wheat varieties with good behavior to pathogens attack for each technological condition.

Is already known that ARDS Simnic area is placed in the center of *Tilletia* species areal and the new races selection is fast. Considering these aspects it was tested new products used for seed treatment against *Tilletia* species.

The objectives of present study were:

- To verify the behavior of wheat varieties to specific pathogens attack;
- To establish the frequency, severity and attack degree values for the pathogens in the experiment period during different wheat growth stages;
- To verify the influence of technological conditions to pathogens attack;
- To compare the results and to express conclusions;
- To establish the technological conditions which influence negatively growth, development and pathogens evolution;
- To verify the yielding capacity of tested wheat varieties;
- To made recommendations for farmers from ARDS Simnic area for their crops protection and economical efficiency.

The experiences realized during 2007-2009 were focus on the attack of the pathogens which affect wheat leaves and heads. During experimental period have been evaluated for their response to natural infection conditions fifty varieties with different origins divided in two groups CCC1 and CCC2.

There were realized three experiences in different technological conditions and the layout was a split plots design with three replications, as follows:

1. Experience I with three factors: **variety**- CCC1 ((Briana, Glosa, Frini, Dunai, Josef, Carolina, Capo, Fridoline, Autan, Aztec, Apache, Bercy, Cezanne, Enesco, Renan, Serina, Cubus, Cordiale, Meunier, Exotic, Orion, Martina, Mariska, Renesansa și Isengrain) and CCC2 (Dropia, Boema, Flamura 85, Exotic, Aniversar, Esențial, Iași 2, Magistral, Moldova 83,

Orqual, Dana, Karlygash, Mandolin, GK David, Romansa, Galil, Ciprian, Giovani, Pobeda, Novisad 7000, Paulus, Ibis, Mina, Banca și Giava);

Fertilizing level – conventional with low nitrogen rate N40P40 (basal applied in autumn) and conventional with high nitrogen rate N100P40 (split rates - basal applied in autumn and top-dressed in early spring);

Diseases scoring time – **m1** - Z39-the last ligulate leaf, **m2** - Z53-1/4 of head, **m3** - Z61-beginning of the flowering.

2. Experience II with three factors: variety- CCC1 ((Briana, Glosa, Frini, Dunai, Josef, Carolina, Capo, Fridoline, Autan, Aztec, Apache, Bercy, Cezanne, Enesco, Renan, Serina, Cubus, Cordiale, Meunier, Exotic, Orion, Martina, Mariska, Renesansa și Isengrain) and CCC2 (Dropia, Boema, Flamura 85, Exotic, Aniversar, Esențial, Iași 2, Magistral, Moldova 83, Orqual, Dana, Karlygash, Mandolin, GK David, Romansa, Galil, Ciprian, Giovani, Pobeda, Novisad 7000, Paulus, Ibis, Mina, Banca și Giava);

Sowing time – normal time (16.oct) and delayed time (30.oct.);

Diseases scoring time – **m1** - Z39-the last ligulate leaf, **m2** - Z53-1/4 of head, **m3** - Z61-beginning of the flowering.

3. Experience III with three factors: variety- CCC1 ((Briana, Glosa, Frini, Dunai, Josef, Carolina, Capo, Fridoline, Autan, Aztec, Apache, Bercy, Cezanne, Enesco, Renan, Serina, Cubus, Cordiale, Meunier, Exotic, Orion, Martina, Mariska, Renesansa și Isengrain) and CCC2 (Dropia, Boema, Flamura 85, Exotic, Aniversar, Esențial, Iași 2, Magistral, Moldova 83, Orqual, Dana, Karlygash, Mandolin, GK David, Romansa, Galil, Ciprian, Giovani, Pobeda, Novisad 7000, Paulus, Ibis, Mina, Banca și Giava);

Seed rate – 550 germinate seeds/m² and 275 g.s./m²;

Diseases scoring time – **m1** - Z39-the last ligulate leaf, **m2** - Z53-1/4 of head, **m3** - Z61-beginning of the flowering.

During the experimental period were realized observations in the field and in the laboratory for the following pathogens:

2006-2007 – *Fusarium sp.* (Fusarium Head Blight), *Cladosporium herbarum*, *Alternaria triticina* (Black Point)

2007-2008 – *Pyrenophora tritici-repentis* (Tan Spot)

2008-2009 – *Pyrenophora tritici-repentis* (Tan Spot) and *Septoria tritici* (Spot Blotch).

The growth stages were determined according with Zadock scale (Zadocks et al., 1974). The evaluation of *Pyrenophora tritici-repentis* started when it was observed on the leaves the first chlorotic or/and necrotic symptoms which coincide with stages Z39. The visual scoring of the pathogen attack intensity was realized using a quantitative scale Saari and Prescott (1975) developed for foliar diseases (0-9), modified by Raymond scale (Raymond et. al., 1985). It was determined the attack degree (AD%)(Savescu et al., 1969) which express the disease percent severity. It was also calculated The Area under Diseases Progress Curve (AUDPC) for whole plant using the formula developed by Shaner and Finney (1977), which express the diseases quantity.

For the evaluation of *Septoria tritici* was used Bronnimann scale (Bronnimann, 1968) and Diseases Coefficient Progress using formula:

SPC= Disease high (cm)/plant height (cm)

The control was established the lowest attack degree or AUDPC value. The wheat varieties free from pathogens attack weren't considered for statistical evaluation. To the maturity the variants were harvest individually.

In the laboratory were determined:

- Protein content (Inframatic Grain Analyzer – Patern Instruments);
- Total nitrogen (%), protein (%), phosphorus (%) and potassium (%) for both green plants and seeds;
- Chlorophyll „a” and „b” , carotene;
- Peroxidases and catalases

Considering that one of the most important wheat pathogens from ARDS Simnic are *Tilletia* species it was realized an experience with different new pesticides used for seed treatment. The wheat variety was Dropia. Before sowing with three days the amount of seed necessary was contaminated and treated with 4 g of *Tilletia caries* theliospores to 1 kg seeds to realize a high infection pressure. The variant 1 was the control and the seeds was contaminated but without treatment. It was used the slurry method. The experience was design as latin square with twenty variants and four replications.

The Obtained Results:

All fifty wheat varieties tested during experimental period presented a large variability offering the opportunity to select the resistant varieties.

In 2007 when the wheat varieties were sowing at normal time (16.oct) in the conditions of *Fusarium* species attack the varieties Aztec, Glosa, Enesco, Renesansa, Martina, Orion (CCC1) and Flamura 85, GK David, Dana, Dropia and Boema (CCC2) recorded the lowest percent of seeds affected by *Fusarium* sp.

The relation between yield and seeds affected by *Fusarium* sp. of the varieties sowing at normal time showed that for each yield increase with 100 kg/ha the percent of seeds with *Fusarium* decrease with 1,21% (CCC1 varieties) and 1,5% (CCC2 varieties).

For both experiences the correlation coefficient between yield and percent of seeds affected by *Fusarium* sp. in normal sowing time conditions was very significant negative.

When the wheat varieties were sowing at delayed time (30.oct) the varieties Cezanne, Exotic, Josef, Serina, Apache, Glosa, Martina, Enesco, Renesansa and Aztec (CCC1) and Pobeda, Iași 2, Magistral, Ciprian, GK David, Flamura 85, Dana, Dropia și Boema (CCC2) recorded the lowest *Fusarium* sp. attack values.

The relation between yield and seeds affected by *Fusarium* sp. of the varieties sowing at delayed time showed that for each yield increase with 100 kg/ha the percent of seeds with *Fusarium* decrease with 0,77% (CCC1 varieties) and 1,6% (CCC2 varieties).

The correlation coefficients between yield and seeds affected by *Fusarium* sp. of the varieties sowing at delayed time were -0,42 (CCC1- distinct negative significant) and -0,64 (CCC2 – very negative significant).

The varieties Fridoline, Carolina, Capo, Cordiale and Cubus (CCC1) and Mina, Giovani, Essential and Ibis (CCC2) presented the lowest percents of seeds with Black Point for both sowing times.

The relation between yield and seeds with Black Point of the varieties sowing at normal time showed that for each yield increase with 100 kg/ha the percent of seeds with Black Point increase with 1,4% (CCC1 varieties) and 0,9% (CCC2 varieties).

The correlation coefficients between yield and seeds with Black Point of the varieties sowing at normal time were 0,50 (CCC1- distinct positive significant) and 0,56 (CCC2 – very positive significant).

The relation between yield and seeds with Black Point of the varieties sowing at delayed time showed that for each yield increase with 100 kg/ha the percent of seeds with Black Point increase with 0,4% (CCC1 varieties) and 1% (CCC2 varieties).

The correlation coefficients between yield and seeds with Black Point of the varieties sowing at delayed time were 0,18 (CCC1- insignificant) and 0,47 (CCC2 – distinct positive significant).

The varieties Mina, Giovani and Esential (CCC2) recorded the lowest percent of seeds with Black Point for both sowing times. All other varieties recorded different values and the resistance is specific for each variety.

The attack of the pathogen *Pyrenophora tritici-repentis* was higher in 2008 year comparatively with 2009 year depending on the climatic conditions.

The varieties from CCC1 were more sensitive to this pathogen attack comparatively with those from CCC2.

For both years the highest values of the *Pyrenophora tritici-repentis* attack were recorded in the third determination moment (Z61- beginning of the flowering) for all technological conditions due to the climatic conditions and the inoculum amount.

Among the twenty-five wheat varieties from CCC1 during 2008-2009 years only eleven varieties showed symptoms (Briana, Glosa, Josef, Autan, Apache, Enesco, Renan, Meunier, Exotic, Orion and Mariska).

For the varieties from CCC2 only five showed attack symptoms ((Exotic, Esențial, Iași 2, Orqual and Mandolin).

When the plants were fertilized with low nitrogen rate N40P40 the pathogen attack ranged between 10,05% (2008) and 8,37% (2009), while when the plants were fertilized with high nitrogen rate N100P40 the values ranged between 7,31% (2008) and 5,32% (2009). The difference between the attack degree on N100P40 comparatively with N40P40 was very negative significant for both years, meaning that the pathogen was more aggressive on N40P40 nitrogen rate.

The attack degree and AUDPC values recorded at both fertilizing levels showed that the pathogen is more aggressive on N40P40 according with studies realized in other countries.

The relation variety x fertilizing rate showed that the attack degree presented different values depending on wheat variety, fertilizing rate, resistance, defense mechanisms, susceptibility and the infections.

The lowest attack degree values were recorded on N100P40 by the varieties Meunier, Serina and Renesansa, while on N40P40 the lowest values were recorded by Renesansa, Orion and Cubus (CCC1).

The attack degree depends by the diseases scoring time for both years and fertilizing rates and records an increase starting with the first moment of evaluation.

On both fertilizing rate the lowest attack degree values were recorded by Meunier, Renesansa, Cubus and Martina and the highest values were recorded by Renan, Autan, Exotic and Josef (CCC1).

For the varieties from CCC2 the lowest attack degree values were recorded by Esential and Iasi 2, while the highest values were recorded by Exotic and Mandolin.

When the wheat varieties were sowing at normal time the pathogen attack degree ranged between 4,28% and 6,51% and between 5,33% and 7,31% for delayed sowing time. The difference between the attack degrees recorded at both sowing times was very negative significant for both years, meaning that *Pyrenophora tritici-repentis* is more aggressive at normal sowing time.

The AUDPC values ranged between 168,44 and 179,98 at normal sowing time and between 131,39 and 171,06 at delayed sowing time. The difference between the values for both sowing times was statistically assured for both years.

The highest attack degree values were recorded for both sowing times and to all moments by Autan and Renan.

When the wheat varieties were sowing at 550 germinate seeds/m² the pathogen attack ranged between 4,28% and 6,51% (CCC1) and between 6,05 % and 8,1% when varieties were sowing at 275 g.s/m².

The AUDPC value in 2008 ranged between 131,39 and 171,06 (550 g.s/m²) and 177,59 and 215,16 (275 g.s/m²).

The difference between the attack degree and AUDPC values at 275 g.s/m² density comparatively with those recorded at 550 g.s./m² density (control) was very positive significant, meaning that the pathogen is more aggressive at 275 g.s/m².

In case of *Septoria tritici* attack the attack values were low because of large temperatures variation between day and night (up to 7°C).

Only the varieties Briana, Glosa, Josef, Fridoline, Apache, Renan, Meunier, Exotic, Renesansa (CCC1) and Dropia, Boema, Flamura 85, Moldova 83, Karlygash, GK David, Ciprian (CCC2) recorded different attack degree values to *Septoria tritici*.

The *Septoria tritici* attack degree was 0,53-0,56% on N40P40 and 1,31-2,27% on N100P40.

The highest attack value in 2009 was recorded by Renan (2,03%).

The values recorded on N40P40 were lower and ranged between 0,10% (Briana) to 1,60 (Renan).

For the wheat varieties from CCC2 the attack degree ranged between 0,28 (Eessential) and 4,43% (Karlygash) on N100P40.

When the nitrogen rate increases the plants height and the diseases progress are superior comparatively with lower nitrogen rate. For the varieties Renan and Fridoline the plants height is higher on N40P40.

Can be emphasized with high differences of plants height and diseases progress for both rates the varieties Ciprian (8 cm), GK David (6,67 cm), Magistral (5,66 cm), Boema (5 cm).

It was observed that the nitrogen rate influence the *Septoria tritici* attack and this is positively influenced by high nitrogen rate.

Among the twenty-five wheat varieties only four (Briana, Glosa, Josef and Fridoline) presented symptoms of *Septoria tritici* attack for both sowing times.

The attack degree values are superior at normal sowing time (1,31%), comparatively with those recorded at delayed sowing time (0,23%).

The highest attack degree value at normal sowing time was recorded by Renan (2,30%).

At different sowing rates only Briana and Fridoline presented significant symptoms on the leaves.

For wheat varieties sowing at 550 g.s./m² the attack degree values ranged between 0,01% (Exotic and Reneasansa) and 1,05% (Fridoline).

For the varieties sowing at 275 g.s/m², the *Septoria tritici* progress is higher.

The protein content of the varieties from CCC1 on N40P40 ranged between 9,02% (Apache) and 11,22% (Briana), while on N100P40 ranged between 11,08% (Cezanne) and 14,42% (Isengrain).

The protein content of the varieties from CCC2 on N40P40 ranged between 9,06% (Ibis) and 10,67% (Dropia), while on N100P40 ranged between 11,59% (Ibis) and 13,78% (NOVISAD 7000).

The protein content is superior for all varieties at N100P40 fertilizer rate.

The yield of the varieties from CCC1 at N100P40 fertilizing rate ranged between 3530 kg/ha (Meunier) and 5145 kg/ha (Aztec). The average was 4226 kg/ha.

The yield of the varieties from CCC1 at N40P40 fertilizing rate ranged between 3144 kg/ha (Meunier) and 4524 kg/ha (Cezanne). The average was 3919 kg/ha.

When the varieties were sowing at delayed time, the yield ranged between 2977 kg/ha (Meunier) and 4366 kg/ha (Aztec). The average was 3609 kg/ha.

When the varieties were sowing at 275 g.s./m² rate, the yield ranged between 2813 kg/ha (Meunier) and 4145 kg/ha (Aztec). The average was 3566 kg/ha.

The varieties Aztec, Orion and Frini recorded the highest yields on N100P40, normal sowing time and 275 g.s./m²rate.

Good yields recorded also Renesansa with a good behavior to *Pyrenophora tritici-repentis* and free of *Septoria tritici*.

The varieties Autan and Renan presented the same attack degree values to *Pyrenophora tritici-repentis*, but the yields were very different for all technological conditions.

Renan recorded low yields for all technological conditions.

Meunier recorded the lowest attack degree to *Pyrenophora tritici-repentis*, but the yields recorded were low, it was the last cultivar.

For the varieties from CCC2 the yield ranged between 3716 (Essential) and 4862 kg/ha (Pobeda) at N100P40 fertilizing rate. The average was 4211 kg/ha. The highest yields were recorded by Pobeda (4862 kg/ha), Ciprian (4584 kg/ha) and Romansa (4566 kg/ha).

At N40P40 fertilizing rate the yield ranged between 2346 kg/ha (Mandolin) and 3957 kg/ha (Ciprian). The average was 3453 kg/ha. The highest yields were recorded by Ciprian (3957 kg/ha), Romansa (3835 kg/ha) and Bancal (3806 kg/ha).

Yunta 246 Sc fungicide used as standard offer the best protection and good yield (4381 kg/ha).

When seeds are treated with Protilin the attack degree was 14,62% and the yield is also low (3868 kg/ha).

The best efficiency was offered by the following varieties: ACH 75-312 FS 2,5 l/t, CIG 3FS 1 l/t, MCW 675 2l/t, Maxim Extra 050 FS 1 l/t, S 230 2,5 l/t, S 345 3,5 l/t, S 380 2 l/t, S 570 3 l/t, Tebuconazol CIG 2 WS 1,5 kg/t, Tebuconazol CIG 6 FS 0,5 l/t, ICP-Cloros 10 kg/t.

The highest yields were recorded when seed was treated with S 570 – 3l/t (4577 kg/ha), CIG 3FS – 1l/t (4505 kg/ha) and Tebuconazol CIG 2 WS – 1,5 kg/t (4498 kg/ha).

Recommendations:

Actually the most economic and efficiency method to control pathogens attack is genetic resistance.

The sowing time has an important role in the development of wheat pathogens, thus is necessary that farmers to know the specific pathogens for their areas and also to be informed about the climatically conditions.

The technological conditions play an important role in the pathogens control.

Among the tested technological conditions the pathogen *Pyrenophora tritici-repentis* can be control using together high nitrogen rate (N100P40), normal sowing time and 550 g.s./m², while *Septoria tritici* can be controlled by low nitrogen rate (N40P40).

Even if to the global level the losses caused by *Pyrenophora tritici-repentis* ranged between 3-15%, rarely 50%, affecting wheat heads and grains, in ARDS Simnic area it was observed a difference between fungus cycle and wheat growing stages, meaning that the pathogen didn't affect significantly the flag leaf and spike.

To avoid high attack degrees caused by *Pyrenophora tritici-repentis* is recommended to use early varieties, such as Briana, which are in advanced growing stages when the pathogen became aggressive according to climatically conditions.

To control *Tilletia* species attack is recommended seed treatment with one of the products: S 570 3 l/t, Tebuconazol CIG 2WS 1,5 kg/t, CIG 3FS 1 l/t.

Because its high yielding capacity in ADRS Simnic area wheat varieties Aztec, Orion, Frini, Ciprian, Romansa, Autan, Pobeda are recommended.

Meunier variety is not recommended for ARDS Simnic area because its low yielding capacity, despite its tolerance to *Pyrenophora tritici-repentis* in all tested technologies.

Renan variety is not recommended also for ARDS Simnic area because presents high sensibility to the specific wheat pathogens attack and recorded also low yields, despite its high protein content.

The research results can be useful for researchers and farmers which can efficiently control the wheat pathogens choosing proper cultivars and cropping technologies.