



INTRODUCTION

Leaf rust, caused by *Puccinia recondita* f.sp. *triticea*, and powdery mildew, caused by *Blumeria graminis* f.sp. *tritici*, are the most prevalent of all of the world wheat diseases in many regions of the world including Poland. These two diseases can cause serious epidemics in Poland. Highly effective strategy in the present plant breeding programs is an introduction of several resistance genes into one genotype. Pyramiding resistance genes for leaf rust and powdery mildew combined with the MAS is very effective process to obtain new cultivars resistant to these diseases. Moreover, in breeding programs there are several examples of the successfully introduction resistance genes into a single cultivar and molecular markers are commonly used in this process. There are several reports on introduction Lr and Pm genes into wheat: Lr10-Lr13-Lr14b-Lr30-Lr34-Yr18 into Opata 85, Lr3-Lr17-Lr23-unknown Lr, Pm4a-Pm21, Pm2-Pm21, Pm2-Pm4a in the Chinese Yang158, Pm2-Pm5, Pm2-Pm6, Pm3d-Pm4b, Pm3d-Pm4b-Pm, Pm1-Pm2-Pm9-Pm4b in the Polish wheat cultivars [1;2].

GOAL

The aim of the presented research is gene pyramiding of leaf rust and powdery mildew resistance genes, like (Lr41-Pm21-Lr47), (Lr41-Pm21-Pm37), (Lr41-Lr47-Pm21-Pm37), (Lr41-Lr55-Pm37) and (Lr41-Lr55-Pm21-Pm37) in a one genotype. The second objective of our study is to clarify the location Lr55 gene in wheat genome and mapping closely linked molecular markers suitable for markers assisted selection (MAS).

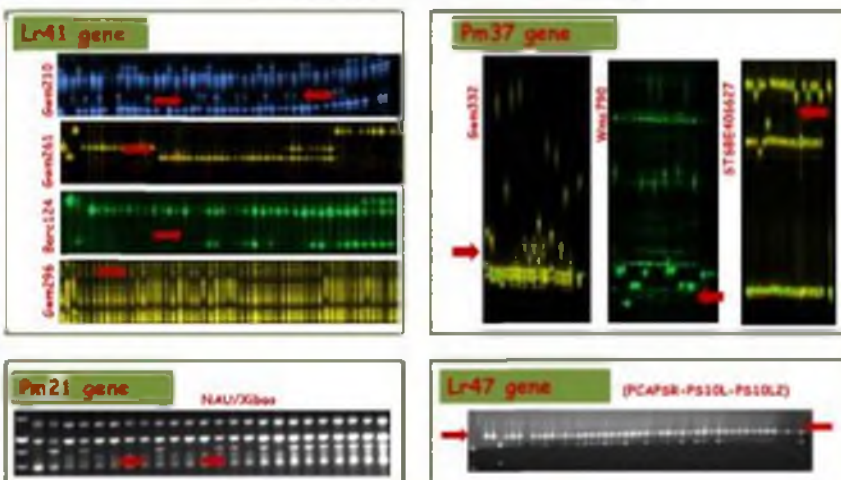
PARENTAL PLANT

1. Recurrent Parents (RP) - 4 varieties of winter wheat: Nadobna, Bogatka, Muszelka, RAH979.
2. Donor lines:
 - line KS90W6RC10 = Lr39 (-Lr41) gene, as the sources of resistance to leaf rust derived from *T. tauschii*,
 - line UC996610010 = Lr47 gene, as the sources of resistance to leaf rust derived from *T. speltoides*,
 - line KS04W6RC45 = Lr55 gene, as the sources of resistance to leaf rust derived from *Elymus trachycaulis*,
 - line Yangmai 5 = Pm21 gene, as the sources of resistance to powdery mildew derived from *Dasyphyrum villosum*,
 - line NC99BGT11 = Pm37 gene, as the sources of resistance to powdery mildew derived from *T. timopheevii*.



MOLECULAR ANALYSIS - FOREGROUND SELECTION

1. Screening Lr39 gene: Gdm35, Barc124, Gwm210, Gwm261, Gwm296.
2. Screening Lr47 gene: PCAPSR-PS10L-PS10L2, Gwm60.
3. Screening Lr55 gene: DArT.
4. Screening Pm21 gene: NAU/xibao.
5. Screening Pm37 gene: Gwm332, Wmc790, STSBE406627.



RESULTS

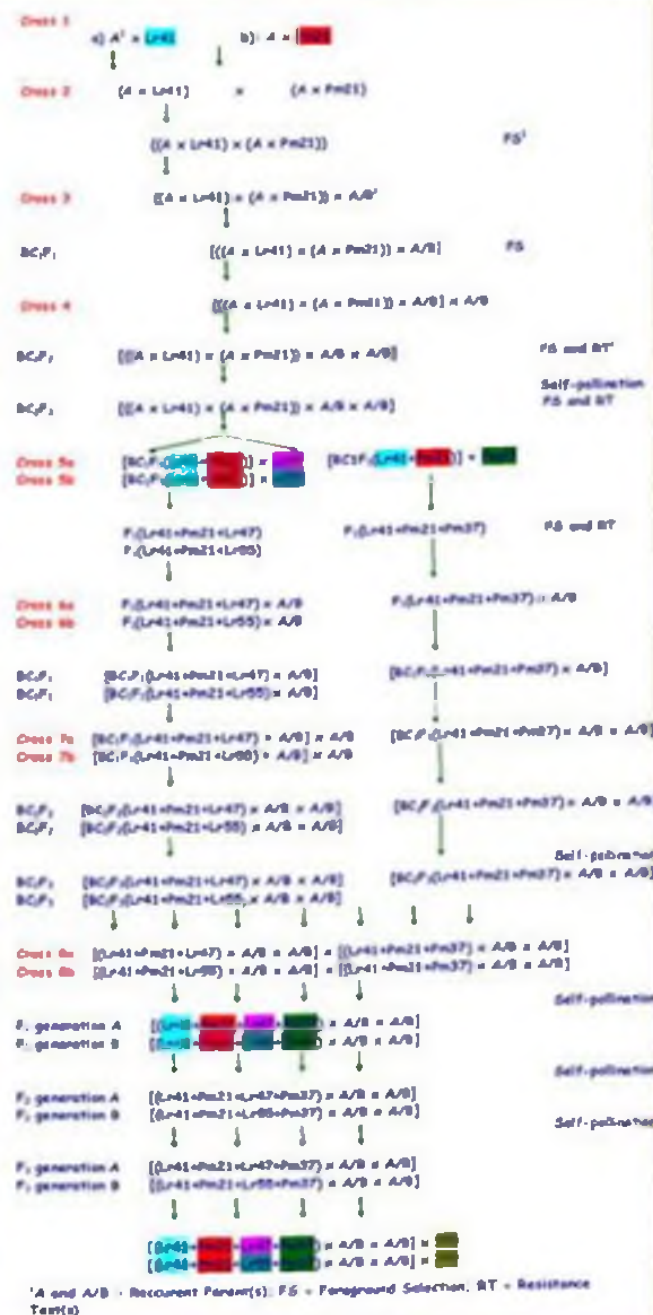
Up to now, the following populations were obtained:

1. (((Nadobna x Lr41) x (Nadobna x Pm21) x Nadobna) x Nadobna) x Lr47 x Nadobna x Nadobna
2. (((Nadobna x Lr41) x (Nadobna x Pm21) x Nadobna) x Nadobna) x Pm37 x Nadobna x Nadobna
3. (((Bogatka x Lr41) x (Bogatka x Pm21) x Bogatka) x RAH979) x Lr47 x Nadobna x Nadobna
4. (((Bogatka x Lr41) x (Bogatka x Pm21) x Bogatka) x RAH979) x Lr47 x Bogatka x Bogatka
5. (((Bogatka x Lr41) x (Bogatka x Pm21) x Bogatka) x RAH979) x Pm37 x Nadobna x Nadobna
6. (((Bogatka x Lr41) x (Bogatka x Pm21) x Lexus) x Meteor) x Pm37 x Pm37 x Bogatka
7. (((Nadobna x Lr41) x (Nadobna x Pm21) x Nadobna) x Nadobna) x Lr55 x Nadobna x Nadobna
8. (((Bogatka x Lr41) x (Bogatka x Pm21) x RAH979) x RAH979) x Lr47 x Bogatka x Bogatka
9. (((Bogatka x Lr41) x (Bogatka x Pm21) x Lexus) x Meteor) x Lr55 x Bogatka x Bogatka

SUMMARY

In summary, pyramiding of several resistance genes using marker assisted proved that this strategy is more efficient and speed up recurrent genome recovery. However, this approach can not completely replace the traditional methods, especially for verification of the results in pathology tests. The resistance tests using differential set of host and pathogen are essential in MAS, especially when the foreground selection results can be sometimes problematic to interpret. The practical outcome of presented study are, the newly produced homozygous wheat lines which can be used as the source of effective resistance for the leaf rust and powdery mildew in breeding programs.

BREEDING SCHEME



REFERENCES

1. Pietrusińska A., Czembor J. H., Czembor P. Cz. 2011. Pyramiding of two resistance genes for leaf rust and powdery mildew resistance in common wheat. *Cereal Research Comm.* 39(4) 577-588
2. Pietrusińska A., Czembor J. H., Czembor P. Cz. 2013. Lr39 + Pm21: a new effective combination of resistance genes for leaf rust and powdery mildew. *Czech Journal of Genetics and Plant Breeding* (in print)