A meta analysis of partial resistance loci to powdery mildew in wheat

Morten Lillemo[1] *& Qiongxian Lu*[1,2]

[1]Norwegian University of Life Sciences, Department of Plant Sciences, P.O Box 5004, NO 1432 Ås, Norway
[2]Current address: Aarhus University, Department of Molecular Biology and Genetics, Research Centre Flakkebjerg, DK-4200 Slagelse, Denmark

Powdery mildew, caused by the biotrophic pathogen *Blumeria graminis* f. sp. *tritici* is a wheat disease of global significance.Two types of resistance are generally considered: race-specific resistance, which is usually monogenic, and race-nonspecific partial resistance that allows some infection, but slows down the disease development. Due to the often-observed short longevity of race-specific resistance, there is an increasing interest among breeders to utilize partial and race non-specific resistance, which can be facilitated by marker-assisted selection. Many sources of potentially durable partial resistance to powdery mildew have been subjected to QTL mapping studies during the last two decades. In the present meta analysis, we have reviewed the powdery mildew QTL mapping literature, with special focus on adult plant resistance of wheat cultivars and breeding lines with documented race non-specific resistance. The locations and confidence intervals of each reported QTL were projected onto the wheat consensus map. A total of 22 studies were reviewed, including a total of 96 QTL. QTL for adult plant resistance were reported on all 21 chromosomes, and the meta analysis showed a total of 39 QTL regions. Out of these, 14 regions were found to be common among at least two independent studies with documentation for race non-specificity of the resistance as shown in the following table:

Meta QTL	Resistance sources	Meta QTL	Resistance sources	Meta QTL	Resistance sources
1AS	Naxos	2BL	Massey, USG3209, RE9001, Naxos, Lumai 21	5BSc	Saar, Folke
1Ac	Oberkulmer, Bainong 64	2DL	Oberkulmer, Lumai 21, Folke, Naxos	5DL	RE714
1BL	Massey, USG3209, Saar	4BL	Forno, Avocet	6BS	Bainong 64, Folke
2AL	Forno, Massey, USG3209, Naxos	4DL	Bainong 64, RL6077	7DS	Opata 85, Fukuho-komugi, Saar, Naxos, Strampelli, Libellula, Chinese Spring
2BS	Festin, Folke, Pingyuan 50, Lumai 21	5AL	Oberkulmer, Saar, Folke		

Interestingly, all three known pleiotropic disease resistance loci *Lr34/Yr18/Pm38*, *Lr46/Yr29/Pm39* and *Lr67/Yr46/Pm46* showed up as meta QTL in this study. These are promising loci that in addition to powdery mildew resistance also will provide some protection against all three rust diseases in wheat, and should be combined with other confirmed QTL for powdery mildew resistance.