

## Breeding for multiple disease and multiple gene resistance in barley

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Combining genes for disease resistance is very difficult, as most breeding programs can only test for the diseases present at their breeding sites. In addition, pyramiding genes or developing multiple gene resistance is difficult to detect when testing at only one location. Multiple disease and gene resistance involves breeding against more than one pathogen and more than one gene per pathogen. Each pathogen may have several races that are able to attack varieties and render a resistant variety ineffective in a short period of time, presenting a significant challenge to plant breeders.

Over the years the ICARDA/CIMMYT barley program in Mexico has given us an excellent opportunity to screen for multiple gene resistance for Scald in barley and at the same time look at multiple disease resistance to Stripe Rust, Barley Yellow Dwarf Virus, Leaf Rust, and Fusarium Head Blight (FHB). In Canada not only have we screened for Scald, but have also screened for Loose Smut and Covered Smuts as well as Net Blotch (net and spot forms), Spot Blotch, and FHB. Over the last 5 years we have screened over 2000 breeding lines at 4 locations in Canada and 3 locations in Mexico. New combinations of resistance genes have been found with some lines containing genes for resistance to 5 and 6 diseases. We found multiple gene combinations for scald resistance that have 3 or more genes and should give durable resistance to this disease in both countries. In order to classify breeding lines according to resistance gene combinations, we are currently analyzing overall similarity computed from multivariate disease resistance data and matching it to the pedigree.

The best lines will be used in the breeding program in order to rapidly incorporate even greater disease resistance into new varieties for Alberta producers. We will also develop several populations to begin the process of mapping on as many of these genes as possible. Continuation of this research is necessary to anticipate and cope with the changes in disease problems likely to occur in the future. Up to this point in time, stripe rust has not been a problem in Alberta on barley; however, in 2004 this disease was found on barley at Olds, Trochu, Calmar and Lacombe. If this disease continues its move north it will be devastating to Alberta's barley crop. FHB also is not presently a problem in Alberta but seems to be moving west. FHB has cost the barley industry millions of dollars in the Midwest in the United States and in Manitoba in Canada.