Lecture 3

Wheat Rusts: Breeding for Resistance

Which rust? – the resistance options for stem rust, leaf rust and stripe rust will be different.

The approach – will vary depending upon many factors:

- No background knowledge of host genetics or pathogen variability vs carefully chosen races released at specific testing sites.
- What facilities are available, or will be used.
- Seedling or APR.
- What testing site(s); why?
- Will nurseries be inoculated? If so, with what? If race mixtures are used, how many and how will they be monitored?
- Will molecular markers be used? How will they be used in conjunction with greenhouse and/or field testing?
- How will the rust and molecular labs interact with, or service breeding programs? Will tests be free or fee-for-service? Will the rust lab(s) do the testing for them, either free of charge or by fee, provide/sell inoculum to them, or provide advice only.
- How will new races be handled while they are restricted to particular areas within the country (risk analysis).
- Is rust resistance a legal or agreed requirement for variety release?

Some rules and realities

- Resistance must be used in conjunction with maximum yield potential. Farmers and marketers usually will not accept lower yielding resistant varieties.
- The resistance assessment procedures must fit the breeding system, in terms of timing and stages in variety development, keeping in mind that breeders vary in the way they conduct their operations. Generally, they will prefer to select for disease resistance in the early stages of breeding so that only resistant lines are carried into the agronomic trialling stages.
- Decisions must be made on how and where disease response testing is done.
- If slow rusting APRs are preferred, then major genes must be avoided (by not using parents with such genes, or selecting against such genes in early generations), or races that overcome them must be used.
- Methods and procedures should be as simple as possible.
- There may be a need for agreement on resistance standards for breeders across the country. Decisions must be made on how those standards will be applied in making decisions on variety release.
- Resistance breeding must be relevant to the current situation, and should be pre-emptive where possible. For some of us breeding for resistance to race Ug99 is current; for others, it is pre-emptive. We must keep in mind the

crosses currently being made by breeders may develop into the varieties that will be grown 10 years from now.

Pre-emptive resistance breeding strategies

Pre-emptive resistance is breeding for resistance to races you do not have now, but predict to occur in the future.

What are those races and where are they likely to come from?

- Mutants of current races that overcome a currently widely used gene. Can we predict the race(s) in which such a mutation is likely to occur? If so, we can focus on different sources of resistance to the particular race
- Migrant races from neighbouring countries.
- Sexual and asexual recombinants (not really predictable)
- Races introduced by human activities (not predictable)
- The BGRI program on pathogen surveillance and breeding for resistance using testing sites in Kenya and Ethiopia is an excellent example of pre-emptive resistance breeding at the international level.

Disease hotspots

What is a rust hotspot?

- An ideal environment for rust development. East Africa has had this reputation for more that 50 years.
- Often infers a place for a high level of pathogenic variability, but that needs to be demonstrated at particular times.
- May also be a consequence of the farming system (continual cropping, multiple or extended sowing periods, very long season crops, continual presence of susceptible host materials.