A cereal variety mixture - What's in it ?

J.S. Swanston and A.C. Newton

Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA UK

Scottish Crop Research Institute

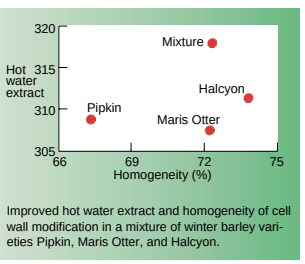
An alternative approach ?

- Reduced inputs and greater sustainability are new plant breeding targets.
- Is the real need for new products or is it for new approaches?
- Breeding seeks to utilise complementary parents, but even modern methods of varietal production take several years.
- Complementary features can be exploited by growing varietal mixtures. The use of existing cultivars means benefits are available immediately.
- Unlike crossing (between 2 parents) there is no restriction on the number of complementary components.
- Mixtures have already been successfully deployed in a number of crops.

Crop	End-use	Country	Disease	Reduction From(%)	To(%)
Barley	Malt/Beer	E. Germany	Mildew	50	10
Coffee	Beverage	Columbia	Rust	N/A	
Rice (Glutenous)	Food	China	Blast	20	1

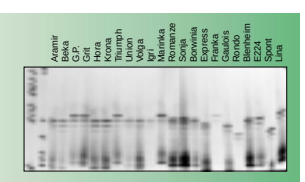
A lot of problems ?

- The use of barley mixtures in E. Germany was terminated after unification, due largely to opposition from W. German maltsters
- UK maltsters remain suspicious citing heterogeneity and difficulties in identification
- Maltsters separate samples on the basis of variety and mean grain nitrogen. They ignore variation between grains and environmental effects.
- Work at SCRI showed a winter barley mixture to be no more heterogeneous than its components and to have better quality.
- What maltsters call homogeneity is, in reality, the level of variation that causes no obvious problems.



Improved hot water extract and homogeneity of cell wall modification in a mixture of winter barley varieties Pipkin, Maris Otter, and Halcyon.

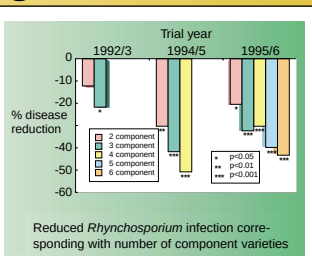
- Mixtures may be perceived as a 'low-tech' approach, but they offer much scope for contemporary approaches
- The use of microsatellites (SSRs) at SCRI has permitted unequivocal identification of barley varieties
- This technology (and/or Single Nucleotide Polymorphims) could be used to identify and quantify mixture components



A simple sequence repeat DNA marker showing differences between barley varieties.

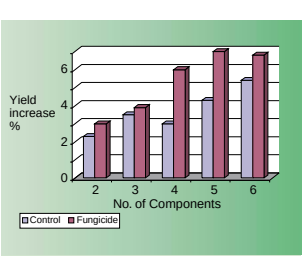
What's in it for the grower ?

- Work at SCRI has shown increasing complexity of mixtures to enhance disease resistance.
- Mixtures are effective against splash-dispersed as well as airborne pathogens
- Currently, effects on canopy structure and competitiveness against weeds are being evaluated



Reduced *Rhynchosporium* infection corresponding with number of component varieties

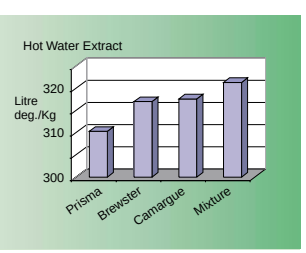
- Increasing the number of components also gave yield increases both with and without fungicide treatment.
- In this particular trial, the yield increase was higher in the treated samples.



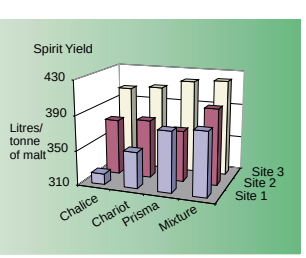
- There are thus complementary effects in addition to disease reduction

What's in it for the end-user ?

- The end-user should obtain improved performance from a lower cost raw material
- SCRI data has shown mixtures frequently to exceed the mean of their components for extract
- Mixtures can, however, exceed all their components



- For distilling, barleys must give high spirit yield after malting
- This requires high fermentability in addition to high extract
- Recent data shows that some mixtures can give high spirit yield



- In addition, they appear less variable across environments than some components

What's in it for the future ?

Molecular methods to predict best parents for crossing will be exploited to select complementary mixture components

Component proportions and spatial arrangements will be modified to best exploit variation across fields

Mixtures could provide better products for niche markets

Grain Whisky Distilling - A Suitable Case for Mixtures?

Annual Requirements:	500k tonnes of soft wheat + 60k tonnes of high enzyme barley
Suitable Varieties:	Few, with limited incentive to breed for local requirement
Penalty for Grower:	Lower yields, higher disease protection costs
Penalty for End-User:	Lower alcohol yield if farmer grows more productive variety

Conclusions

Recent research at SCRI has refuted arguments that mixtures are too heterogeneous or difficult to identify

They may be less variable than their components across environments

They offer a means to best exploit available resources while reducing inputs

They can maintain or even enhance quality

Acknowledgement

Financial support from SEERAD and sponsorship of this presentation by the Scottish Society for Crop Research (SSCR) and Mylnefield Research Services (MRS) are gratefully acknowledged