

Scotland's Rural College

Analysis of Cereal Trials to Evaluate Market and Non-Market Benefits of New Varieties and Their Traits - Poster

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Analysis of Cereal Trials to Evaluate Market and Non-Market Benefits of New Varieties and Their Traits

Supporting the
land-based industries
for over a century



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Introduction

Agriculture is increasingly required to deliver goods that go beyond economic and market requirements and respond to commitments on climate change mitigation, soil and water quality improvement and biodiversity conservation.

EU Directives that require testing for value for cultivation and use (VCU) as part of National Listing (NL) are primarily led by market drivers.

New varieties are normally defined according to market values such as yield and grain quality, but they could also be rated in terms of their environmental or social value such as the reduction of fungicide, herbicide, fertiliser or energy use.

Thus, the testing of new varieties could demonstrate financial benefits as well as contributions to wider climatic, social and agri-environmental drivers.

Trial Design & Analysis

The photographs show a selection of wheat varieties currently grown in the UK. Variety approval from Recommended List (RL) trials is largely based on yield (fungicide treated) and grain quality.

Variety selection and may also consider wider criteria such as yield stability or potential benefits from improved disease resistance ratings.

However, for both market and non-market drivers to be used within VCU testing, as well as in NL and national RL systems, trials will require:

- (1) Designs to differentiate genotype responses across trials series so that the 'environmental' component of $g \times e$ interactions can be subdivided into management and environmental components.
- (2) Methods to assess market and non-market value: including cost-benefit analysis of aggregate returns to the costs of selecting new varieties and their subsequent adoption.

Analyses should include comparison of the relative costs and benefits of new genotypes and their trait combinations with alternative methods such as other research avenues, or governmental policy levers in delivering specified objective outcomes.

Plant traits of general value may include yield without fungicide, improved nitrogen uptake efficiency and widening of sowing dates to offset weed, pest and disease build-up.



Comparing high quality 'Zebedee' with high yield stability in 'Istabraq'



Comparing high yielding 'Oakley' against a low-input option in 'Timber'

Evaluation of varieties and traits

A key step is to assign value to varieties and their traits. Hedonic valuation may be useful in estimating the wider environmental benefits of plant traits. In its simplest form, one such procedure is described by:

$$V_{ij} = F(T_{1ij}, T_{2ij}, \dots, T_{nij}, Z_{ij})$$

Here, V_{ij} is a measure of the economic value of a variety i in location j . T_{1ij} , T_{2ij} , ..., T_{nij} are indexes of traits 1, 2, ..., n of the variety in location j . Z_{ij} is a further measure of economic or environmental factors or benefits associated with variety i .

The present value costs of adopting new varieties can be assessed by comparing values of the variety with alternative approaches, and their expected future benefits, in delivering objectives such as reducing fertiliser or pesticide inputs.

An incremental cost-effectiveness ratio can be considered as:

$$\frac{PV_g - PV_c}{Q_g - Q_c}$$

Here, PV_g is the present value of a new variety, PV_c is the present value of an alternative approach, Q_g is the improvement or benefit with the new variety and Q_c is the improvement or benefit under the alternative approach.

This model can be used to introduce different options for costs and benefits of new varieties and alternatives. A time-frame may also be added to evaluate longer term adoption of a new variety or strategy.

Summary

In future, evaluation of cereal varieties for both market and environmental values would be a significant step towards developing new sustainability criteria; including mitigation or adaptation to climate change and reducing pesticide inputs.

For any given research priority or policy objective; for example mitigation of climate change, protection of biodiversity or reduction of pollution and waste, we can determine whether new varieties or alternative approaches are the best means of delivering the greatest amount of social, environmental or economic benefit.

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