CV values from historical trials as a quality measure: a tool

CV-Werte von historischen Versuchen als Qualitätsmesslatte für Bewertungen: ein Werkzeug

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Agenda

// Bayer field trials
// EPPO standards
// Coefficient of variation
// Scout field trials system
// Examples of reference distributions
// CV inspector tool
// Discussion and questions
Bayer field trials

Bayer conducts around 20000 crop protection field trials globally each year.

They are used to investigate, develop, register and support new product solutions for farmers and growers.
European and Mediterranean Plant Protection Organization (EPPO) Standards

The EPPO Standards for the efficacy evaluation of plant protection products (PP1) describe the **conduct of trials** carried out to assess the **efficacy** of plant protection products against specific pests.

They are addressed to all institutions, official registration authorities, public institutes or **private firms** carrying out such trials.


**PP 1/152(4) Design and analysis of efficacy evaluation trials**

- Relevant standard for statistics
- Implemented by Bayer
3.4.4 Basic structure and sequence of analysis

Before beginning statistical analysis of the results of a trial series, the data of each trial should be validated.

- **Methodological validation** …
- **Agronomic and biological validation** …
- **Statistical validation**: trials should be accurate, showing a typical standard error (or **coefficient of variation**).

**Questions**

- What is a coefficient of variation?
- What values are typical?
- How can we validate trial data in practice?
Coefficient of variation

The coefficient of variation (CV) is a **unitless** measure of **relative variability**. It is defined as the ratio of the standard deviation to the mean expressed as a percentage. (SAS 9.4 Help)

\[
\hat{c}_V = \frac{s}{\bar{x}}
\]

The coefficient of variation … provides a good yard-stick for appreciating the precision possible in an experiment, thereby aiding decisions on the sample size to be taken, and allowing **comparisons of variability** between experiments.


The CV is sometimes used as a standard to gauge the **relative magnitude of error variation** compared with that from similar studies.


The CV on its own can be a poor indicator of quality. Trials that have been under disease, pest or other pressures and, as a consequence provide important genotype discrimination, often produce high CVs.

What is a typical coefficient of variation?

Depends on:

// Site: intrinsic plot variability, application, accidents,
// Assessment: yield, disease, pest, weed species, aggregation.
// Method: measured, estimate, subjective rating, sample.
// Values: low yield, early epidemic => higher CV.

Published values can be found for yield in some crops.

Not enough detail in most published reports.

Cannot compare with our assessments.

Solution: Use our own historical data.
Coefficient of variation and yield

CV can be country-dependent and related to yield.

**CV% against untreated yield of soybeans by country**
4937 trials from 2016-2019

- United States
- Brazil
- Argentina
Coefficient of variation distribution

A histogram is more useful for validation.

Distribution of CV% of soybean yield
4937 trials from 2016-2019
Scout field trials system

The Scout system manages the whole process of planning, running, analysing, reporting and summarising field trials.
Scout statistics for single trials calculates CV

- Meets EPPO standard.
- Automatic based on rules.
- Rules ensure consistency.
- Uses SAS PROC GLM.
- Traditional transforms.
- Saves statistics to database.
- Includes coefficient of variation.
- Used for registration reports.
- Available for query and summary.
CV ranges vary depend on crop/target and assessment type

Examples of reference distributions
CV inspector tool

Use key criteria including crop, target, assess type, assess unit to group CV values

Inspects Excel tables generated by Scout.

- Works with a standard table template.
- Recognises common field labels.
- Finds assessment descriptions automatically.
- Can enter own field labels or assessment descriptions.

Buttons step over sheets and assessments.

Compares CV with similar assessments.

- Detailed: Histogram with current CV marked.
- Statistics: 20th percentile, median, 80th percentile.
- Overview: Format the Excel table with colour scales.

Live demonstration.
CV inspector dashboard

Allows direct database connection

Look up a TPT ID

Select your criteria for CV distribution

CV value distribution
Discussion

Questions
Discussion and questions

Notes from the meeting

Do we use all assessments?

Yes, from trials in the last ten years.

How do we advise colleagues to use CV values? Are there fixed upper limits?

We recommend using CV values with biological expertise. There are no fixed upper limits, but with yield we exclude unusually high values.

As there is a relationship between CV and mean, would it be possible also to include the mean?

In principle yes. A graphic would be possible but units and sample basis would give problems.

A later discussion about the trend for higher yields to have lower CV postulated the possible applicability of Taylor’s Power Law.
Thank you!

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