

## STRUCTURE OF DOCUMENT TGP/8

### INTRODUCTION

#### PART I: DUS TRIAL DESIGN AND DATA ANALYSIS

1. DUS TRIAL DESIGN
  - 1.1 Introduction
  - 1.2 Growing cycles
    - 1.2.1 Introduction
    - 1.2.2 Independent growing cycles
  - 1.3 Testing Place
    - 1.3.1 Purpose
      - (a) Minimizing the overall testing period
      - (b) Reserve Trial
      - (c) Different agro-climatic conditions
    - 1.3.2 Use of information from multiple locations
      - (a) DUS examined at all growing trial locations
      - (b) DUS examined using characteristics examined at different locations
      - (c) DUS examined on the basis of data for the same characteristics examined at different locations
  - 1.4 Conditions for conducting the examination
  - 1.5 Number of plants/Parts of plants to be examined
  - 1.6 Test Design
    - 1.6.1 Introduction
    - 1.6.2 Single plots
    - 1.6.3 Replicated plots (statistical analysis)
      - 1.6.3.1 Introduction
      - 1.6.3.2 Replicated plots for records for a group data
      - 1.6.3.3 Replicated plots for statistical analysis of individual plant data
      - 1.6.3.4 Randomization
      - 1.6.3.5 Randomized incomplete block designs
      - 1.6.3.6 Design for pair-wise comparisons between particular varieties
      - 1.6.3.7 Statistical aspects of trial design
        - 1.6.3.7.1 Introduction
        - 1.6.3.7.2 The use of standard deviation: the hypotheses under test
        - 1.6.3.7.3 Sources of variation
        - 1.6.3.7.4 The impact of precision on analyses over years or cycles
      - 1.6.3.8 Trial elements when statistical analysis is used
        - 1.6.3.8.1 Introduction
        - 1.6.3.8.2 Plots and blocks
        - 1.6.3.8.3 Allocation of varieties to plots
        - 1.6.3.8.4 Plot size, shape and configuration
        - 1.6.3.8.5 Independence of plots
        - 1.6.3.8.6 The arrangement of the plants within the plot/ Type of plot for observation
    - 1.6.4 Blind Randomized Trials
  - 1.7 Additional Tests
2. DATA TO BE RECORDED
  - 2.1 Introduction
  - 2.2 Side-by-side visual comparison
  - 2.3 Notes/Single variety records
  - 2.4 Variety mean/statistical analysis of groups of plants
  - 2.5 Statistical analysis of individual plant data
    - 2.5.1 Introduction
    - 2.5.2 Different levels to look at a characteristic
      - 2.5.2.1 Introduction
      - 2.5.2.2 Understanding the need for process levels
    - 2.5.3 Types of expression of characteristics

- 2.5.4 Types of scales of data
  - 2.5.4.1 Quantitatively scaled data (metric or ordinal scaled data)
    - 2.5.4.1.1 Introduction
    - 2.5.4.1.2 Ratio scale
    - 2.5.4.1.3 Interval scale
  - 2.5.4.2 Qualitatively scaled data
    - 2.5.4.2.1 Ordinal scale
    - 2.5.4.2.2 Nominal scale
- 2.5.5 Scale levels for variety description
- 2.5.6 Relation between types of expression of characteristics and scale levels of data
- 2.5.7 Relation between method of observation of characteristics, scale levels of data and recommended statistical procedures
- 3 CONTROL OF VARIATION DUE TO DIFFERENT OBSERVERS
- 4. VALIDATION OF DATA AND ASSUMPTIONS
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  - 4.2 Validation of data
  - 4.3 Assumptions for statistical analysis and the validation of these assumptions
    - 4.3.1 Assumptions for statistical analysis [/variety means]
      - 4.3.1.1 Introduction
      - 4.3.1.2 Independent observations
      - 4.3.1.3 Variance homogeneity
      - 4.3.1.4 Normal distributed observations
      - 4.3.1.5 Additivity of block and variety effects
    - 4.3.2 Validation of assumptions for statistical analysis
      - 4.3.2.1 Introduction
      - 4.3.2.2 Looking through the data
      - 4.3.2.3 Using figures

## **PART II: TECHNIQUES USED IN DUS EXAMINATION**

1. The method of uniformity assessment on the Basis of Off-Types
  - 1.1 Fixed Population Standard
    - 1.1.1 Introduction
    - 1.1.2 Using the approach to assess uniformity in a crop
    - 1.1.3 Issues to be considered when deciding on the use of the method
    - 1.1.4 Examples
    - 1.1.5 Introduction to the tables and figures
    - 1.1.6 Detailed description of the method for one single test
    - 1.1.7 More than one single test (year)
    - 1.1.8 Detailed description of the methods for more than one single test
      - 1.1.8.1 Combined test
      - 1.1.8.2 Two-stage test
      - 1.1.8.3 Sequential tests
    - 1.1.9 Note on balancing the type I and type II errors
    - 1.1.10 Definition of statistical terms and symbols
  2. The choice of statistical methods for the assessment of distinctness
    - 2.1 Introduction
    - 2.2 Statistical methods for use with two or more independent growing cycles
      - 2.2.1 Introduction
    - 2.3 Statistical methods for use with one growing cycle
    - 2.4 Statistical tests central to the statistical methods
      - 2.4.1 The Least Significant Difference (LSD)
      - 2.4.2 The Multiple Range Test (MRT)
      - 2.4.3 Comparison of the use of the LSD and the MRT in distinctness testing
  3. The Combined Over-Years Criteria for Distinctness and Uniformity
    - 3.1 The Combined Over-Years Distinctness Criterion (COYD)
      - 3.1.1 Summary
      - 3.1.2 Introduction
      - 3.1.3 The COYD method
      - 3.1.4 Use of COYD
      - 3.1.5 Adapting COYD to special circumstances
        - 3.1.5.1 Differences between years in the range of expression of a characteristic
        - 3.1.5.2 Small numbers of varieties in trials: Long-Term COYD
        - 3.1.5.3 Marked year-to-year changes in an individual variety's characteristic
      - 3.1.6 Implementing COYD
      - 3.1.7 References
      - 3.1.8 COYD statistical methods
        - 3.1.8.1 Analysis of variance
        - 3.1.8.2 Modified joint regression analysis (MJRA)
        - 3.1.8.3 Comparison of COYD with other criteria
      - 3.1.9 COYD software
    - 3.2 The Combined-Over-Years Uniformity Criterion (COYU)
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      - 3.2.2 Introduction
      - 3.2.3 The COYU Criterion
      - 3.2.4 Recommendations on COYU
      - 3.2.5 Mathematical details
      - 3.2.6 Early decisions for a three-year test
      - 3.2.7 Example of COYU calculations
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      - 3.2.9 COYU software
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    - 3.3 Schemes used for the application of COYD and COYU
  - 4 Section on 2x1% Method
    - 4.1 2x1% Criterion (Method)
  - 5 Section on Single Growing Cycle Method
    - 5.1 Single Growing Cycle Method

New Section: Chi-Square Test

- 6. Parent Formula of Hybrid Varieties
  - 6.1 Introduction
  - 6.2 Requirements of the method
  - 6.3 Assessing the originality of a new parent line
  - 6.4 Verification of the formula
  - 6.5 Uniformity and stability of parent lines
  - 6.6 Description of the hybrid
- 7. The GAIA methodology
  - 7.1 Some reasons to sum and weight observed differences
  - 7.2 Computing GAIA phenotypic distance
  - 7.3 Detailed information on the GAIA methodology
    - 7.3.1 Weighting of characteristics
    - 7.3.2. Examples of use
      - 7.3.2.1 Determining “Distinctness Plus”
      - 7.3.2.2 Other examples of use
    - 7.3.3 Computing GAIA phenotypic distance
    - 7.3.4. GAIA software
    - 7.3.5 Example with Zea mays data
      - 7.3.5.1 Introduction
      - 7.3.5.2 Analysis of notes
      - 7.3.5.3 Electrophoresis analysis
      - 7.3.5.4 Analysis of measurements
      - 7.3.5.5 Measurements and 1 to 9 scale on the same characteristic
    - 7.3.6 Example of GAIA screen copy
- 8. Examining DUS in bulk samples
  - 8.1 Introduction and abstract
  - 8.2 Distinctness
  - 8.3 Uniformity
    - 8.3.1 Bulking within plot
    - 8.3.2 Bulking across plots
    - 8.3.3 Taking just one bulk sample per plot

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