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ADDENDUM

CYCLIC PLANTING OF ESTABLISHED VARIETIES TO REDUCE TRIAL SIZE;
PROPOSAL FOR TEXT TO BE ADDED TO TGP/8

Document prepared by experts from the United Kingdom

The Annex to this document contains a presentation on Cyclic Planting given by Mrs. Sally Watson, United Kingdom, at the twenty-ninth session of the Technical Working Party on Automation and Computer Programs.

[Annex follows]

ANNEX

Cyclic Planting of Established Varieties to Reduce Trial Size

(text proposal for TGP/8)

- Method of Cyclic Planting of Established Varieties to reduce DUS trial sizes while maintaining testing stringency.
- A subset of the established varieties is omitted from the trial each year and their absence is compensated for in the DUS testing of candidate varieties using historical data
- Is described in TWC/17/11.
Is routinely used in the UK DUS testing of herbage and oilseed rape
- Guidance on the method is proposed for TGP/8 PART II (Selected techniques used in DUS examination)

When to use CYCLIC PLANTING

- When distinctness is determined by COYD
- too many established varieties (cost or practical reasons)
- ≥ 20 degrees of freedom for the varieties-by-years mean square (if not, don't use)

Method

- Allocate established varieties to one of three cycles and omit one cycle in turn each year
- Include candidate varieties for (3yr) test period + 4th year
- If DUS, candidate joins the established varieties in trial, is allocated to a cycle and is omitted from trial every third year
- Distinctness by adapted COYD on incomplete table of variety characteristic means. Missing data is compensated for using two years' data from before the test period
- (Uniformity by COYU on the incomplete table of variety characteristic standard deviations in the 3 yr test period)
- First must use historical data to compare effects of cyclic planting vs existing system on the DUS decisions

Figure 1. **Data patterns and usage for the test period 2014 to 2016**

TRIAL YEARS	2010	2011	2012	2013	TEST PERIOD			2017	2018
					2014	2015	2016		
Candidate Varieties					X	X	X	*	
Established Varieties									
Cycle 1		X	X		X	X		*	*
Cycle 2	O		X	X		X	X		*
Cycle 3	O	X		X	X		X	*	
New Established Varieties – Assimilation into matrix									
Final DUS tested in 2012 (Cycle 2)	O	O	X ^F	X		X	X		*
Final DUS tested in 2013 (Cycle 3)		O	X	X ^F	X		X	*	
Final DUS tested in 2014 (Cycle 1)			X	X	X ^F	X		*	*
Final DUS tested in 2015 (Cycle 2)				O	X	X ^F	X		*

X Indicates data retrieved using maximum of 4 years for distinctness testing and within the (boxed) test period for uniformity testing

O Indicates data present but not retrieved

^F Indicates final DUS test year of new established varieties

* Indicates future inclusion in trial

(within box) Indicates the data used for uniformity testing

Remarks

- Allocation
 - initial allocation to cycles (minimise bias risks),
 - will lose balance over time as candidates become established and established varieties withdrawn
 - don't need perfect balance – to transfer between cycles plant in years when due to be omitted
- Use of back data
 - Don't use more than 2 years of back data – this maintains stringency
 - If all data present in test period, don't use back data

Analysis for distinctness

By adapted COYD
(MJRA of incomplete table of established varieties×6
yrs + complete table of candidate varieties×3 yrs)

The Model

Model for the n cyclic planting data values with n_v varieties in n_y years is:

$$c_{ij} = \mu + y_j + \beta_j v_i + \varepsilon_{ij}$$

where c_{ij} is the value on a characteristic for variety i in year j , $i = 1, \dots, n_v$ and $j = 1, \dots, n_y$

μ is the overall mean

v_i is the effect of the i^{th} variety with $\sum v_i = 0$

y_j is the effect of the j^{th} year with $\sum y_j = 0$

β_j is the sensitivity of year j

ε_{ij} is a random error associated with variety i in year j

Adaptation of Digby, P (1979) model. Is fitted iteratively to get estimates of variety means and LSD's to determine distinctness.

$df = (n - 1 - 2(n_v - 1) - (n_y - 1))$, must be ≥ 20

Example

Variety A represents candidate varieties and varieties B, C and D represent the three cycles of established varieties. The test period is years 4 to 6.

Variety	Year					
	1	2	3	4	5	6
A	-	-	-	6	2	3
B	-	6	4	-	6	7
C	7	10	-	8	11	-
D	11	-	14	10	-	17

Parameter estimates of $\mu, y_1 \dots y_6, \beta_1 \dots \beta_6, v_1 \dots v_4$ as 7.862, (-2.12, 0.55, -1.20, -0.12, 1.16, 1.73), (0.91, 1.14, 1.26, 0.36, 1.39, 1.28), (-5.09, -2.12, 1.38, 5.81). These give ...

Table of Means

Variety	Year						Means
	1	2	3	4	5	6	
A	-	-	-	6	2	3	2.78 = 7.86 + -5.09
B	-	6	4	-	6	7	5.76
C	7	10	-	8	11	-	9.24
D	11	-	14	10	-	17	13.67

Means 5.74 8.42 6.66 7.75 8.92 9.03

Sensitivities 0.91 1.14 1.26 0.36 1.37 1.39

1% LSD values (1df – vy small example dataset! Recommend ≥ 20)

Variety	A	B	C
B	15.75		
C	18.00	15.64	
D	18.39	15.64	18.83

Varieties A and D (difference in means is 10.89) are ND (1% level)

Cyclic planting system software
Program CYCL of DUSTNT

Thank you for your attention