E

TWC/17/2
ORIGINAL: English
DATE: March 17, 1999

UPOV

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

GENEVA

TECHNICAL WORKING PARTY
ON
AUTOMATION AND COMPUTER PROGRAMS

Seventeenth Session
Helsinki, June 29 to July 2, 1999

ON EFFICIENCY OF RESOLVABLE INCOMPLETE BLOCK DESIGN IN DUS TRIAL
ON FRENCH BEAN VARIETIES

Document prepared by experts from Poland

ON EFFICIENCY OF RESOLVABLE INCOMPLETE BLOCK DESIGN IN DUS TRIAL ON FRENCH BEAN VARIETIES

Wieslaw Pilarczyk, Department of Mathematical and Statistical Methods, Agricultural University of Poznan, and
The Research Centre of Cultivar Testing, Slupia Wielka, Poland

1. Introduction

In DUS (distinctness, uniformity and stability) trials the randomized complete block designs are used, as a rule, independently of the number of varieties compared, whereas in VCU (value for cultivation and use) trials, only if the number of varieties is high enough (usually if it is higher than 15), are the incomplete blocks used. Because the number of varieties in DUS trials often exceeds 100, (for example, in the maize trial conducted in 1998 at the experimental station at Slupia Wielka in Poland over 200 varieties were compared), incomplete blocks could be potentially very useful. The discussion about use of incomplete blocks in DUS trials started at the TWC meeting in 1998 at Melle, where two papers connected with that problem were presented. In the first one, Kristensen and Jensen [1998], the efficiency of the experiment on spring rape conducted in Denmark was reported. That experiment was established in resolvable block design and the efficiency of incomplete block analysis was compared with that of randomized complete block. For most characters, the incomplete blocks analysis was more effective than the complete blocks analysis. In a second paper, Pilarczyk [1998], the post-blocking method was used to investigate the potential efficiency of incomplete blocks with different numbers of plots within block applied to the results of maize trial. Again the incomplete blocks were more effective than randomized complete ones. In 1998, at the experimental station at Slupia Wielka, an experiment on French bean was conducted in resolvable incomplete blocks. The results of that trial are analyzed in this paper.

2. The Trial and Data

In the experiment conducted in two replicates, 40 varieties were investigated. Two replications were applied. The experiment was established as resolvable incomplete block design with 10 plots within every block. The field scheme is given in Figure 1. Every incomplete block was subdivided into 10 plots. Both incomplete blocks and varieties within blocks were allocated at random. The varieties were assigned to every incomplete block according the rule of forming incomplete blocks in such a way that the resulting design had the highest mean harmonic efficiency factor, Patterson and Hunter [1983]. The design used had this factor equal to E=0.864

Replication 1

block 1	block 2	block 3	block 4

Replication 2

block 5	block 6	block 7	block 8

Figure 1. Field scheme of experiment on French bean

Plot size was equal to $5m^2$. There were 15 plants from every plot observed giving in total for every variety 30 observations. There were four measurable characteristics measured, namely: c1 - plant height, c2 - pod length, c3 - pod median width, c4 - pod transverse width. The fifth characteristic c5 was calculated as the ratio of pod transverse width to pod median width. Of course there were many other qualitative characteristics observed, but these are not included in this analysis.

3. The Results

For every of fifth characteristics the following analyses of variance have been performed:

a) analysis of incomplete blocks results according to field scheme applied,

b) analysis of randomized complete blocks (ignoring subdivision of replicates into incomplete blocks),

c) analysis of incomplete blocks results for artificial blocks received after subdivision of every incomplete block consisting of 10 plots into two smaller blocks consisting of 5 plots. It is a kind of post-blocking analysis.

The mean harmonic efficiency factors for the designs involved are respectively equal to E_{40}=1 for randomized complete block, E_{10}=0.854 for design with blocks of 10 plots and E_5=0.700 for design with blocks of 5 plots. For every version of analysis the mean square for error MS_e(i) (where (i) means actual number of plots within a block) was calculated and average variance of comparisons of treatment means as well. The results are summed up in Table 1 (below).

Table 1

Efficiency of different analyses of the results of DUS trial on French bean

Measures of efficiency	characteristics				
	c1	c2	c3	c4	c5
$MS_e(40)$	2.902	0.0724	0.0513	0.0410	**0.0006**
$MS_e(10)$	**2.377**	0.0743	0.0486	**0.0365**	0.0007
$MS_e(5)$	2.923	**0.0639**	**0.0480**	0.0368	0.0007
------	------	------	------	------	------
$Var_{40}\left(\overline{y}_i - \overline{y}_j\right)$	2.902	**0.0724**	**0.0513**	**0.0410**	**0.0006**
$Var_{10}\left(\overline{y}_i - \overline{y}_j\right)$	**2.783**	0.0870	0.0569	0.0427	0.0008
$Var_{5}\left(\overline{y}_i - \overline{y}_j\right)$	4.176	0.0912	0.0685	0.0525	0.001

The smallest values for mean squares for error and average variance of comparisons are given in bold print. It is seen that only for characteristic one the mean square for error and average variance was the smallest for incomplete blocks applied. For all other characteristics complete blocks were better.

4. CONCLUSIONS

The analysis of the results of the incomplete blocks trial on French bean conducted at Slupia Wielka in 1998 indicates that:

1. the effectiveness of incomplete blocks depends on the character involved. That effectiveness should be higher for characters more dependent on environment (soil) conditions;

2. the use of resolvable incomplete blocks instead of general incomplete blocks has the advantage that it allows a return to complete block analysis for these analyses for which complete block analysis was more effective than incomplete block analysis. This means that within the same trial for different characters, different analyses could be applicable;

3 additional investigations are necessary to formulate more general conclusions concerning the efficiency of designs of a different kind.

References

Kristensen K., Jensen J.M. (1998). Efficiency of different designs in spring rape, TWC/16/12

Patterson, H.D., Hunter E.A. (1983). The efficiency of incomplete block designs in National and Recommended List cereal variety trials. J. Agric. Sci. Camb. 103, pp. 427-433

Pilarczyk, W. (1998). The possibility of application of incomplete blocks in DUS trials, TWC/16/2

[End of document]