Augmented Blocks

Have both replicated and unreplicated treatments
Replicated treatments are tested in each block as in a RCBD
Unreplicated treatments occur in only one block - so each block has a different set of unreplicated treatments

Advantages
1. Save time and money with smaller blocks
2. Still have critical comparisons
3. Flexible with large numbers of treatments

Disadvantages
1. Less precision for comparing unreplicated treatments
2. Missing data for unreplicated treatment means loss of all information on that treatment

Uses
1. Preliminary screening and selection of treatments for future experiments
    - variety trials
    - drug screening
2. Demonstrations
3. Testing extremes of treatment combinations
4. Extra controls, eg assays

Analysis

Extra controls
1. Use regular ANOVA and orthogonal contrasts to compare controls and treatments
2. Use controls as covariate and correct treatment means based on control measurements.

Extra unreplicated treatments
1. Perform regular ANOVA for replicated treatments
2. Adjust unreplicated treatment means for block effects

Example Experiment

replicated treatments	$t_r = 3$
blocks	$r = 4$
unreplicated treatments per block	$t_u = 2$
(total of 8 unreplicated treatments)	

ANOVA for replicated treatments

Source	df
Total	11
Treatment	2
Block	3
Error	6

Adjustment of unreplicated treatment means for block effect

$$T_{adj} = T_{orig} - (\overline{X}_{.i} - \overline{X}_{..})$$

$$T_{adj} = T_{orig} - \overline{X}_{.i} + \overline{X}_{..}$$

where $\overline{X}_{.i}$ is the mean of the replicated treatments in block i

and $\overline{X}_{..}$ is the overall mean of the replicated treatments

Standard error of the difference depends on whether comparisons are for replicated or unreplicated treatments
Replicated treatment means are averages for all blocks
Unreplicated treatments are single observations

$$SED(repl) = \sqrt{\frac{2MSE}{r}}$$

$$SED(unrepl, same\ block) = \sqrt{2MSE}$$

$$SED(unrepl,\ diff\ block) = \sqrt{2MSE(1 + \frac{1}{t_r})}$$

$$SED(repl\ \&\ unrepl) = \sqrt{MSE(1 + \frac{1}{r} + \frac{1}{t_r} - \frac{1}{rt_r})}$$

LSD = $t_{.05}$SED
df = df for MSE

Strategies for Large Numbers of Treatments

1. Incomplete or augmented factorials

2. Response surface designs

3. Incomplete block designs

4. Fractional factorials

5. Augmented blocks with some treatments unreplicated

6. Stratification of treatments into groups of similar treatments (eg group varieties on the basis of some traits, group assays by time run)
    - Separate trials or blocks for each group
    - Use difference from control to compare treatments in different groups
    - Less accurate than incomplete block
    - Easier to analyze
    - Error variance is not the same for all groups

7. Stratification of treatments into groups and use of split plot design with group as main plot

8. Homogenization of experimental area or experimental units
    - Soil treatment
    - Adaptation diet

9. Use of controls to identify site variability
    - Variability can be systematic or random
    - Use covariance to adjust
    - For assays, rerun if intra-assay variability is too high