Usage of fractional factorial designs for testing the technology of crop production

Dariusz Załuski, Janusz Gołaszewski, Aneta Stawiana-Kosiorek

Department of Plant Breeding and Seed Production, University of Warmia and Mazury, Poland

Testing new technology of crop production requires the application of experimental designs which enable the estimation of simultaneous effects of many agrotechnical factors. For such a test it is natural to consider the factorial experiment of type s^k where k factors are on s levels (usually two or three). However, a drawback of the experiment is an exponential increase of the number of tested treatments with the increased number of factors applied. It implies obvious problems of methodological (soil variability) and economical (costs) nature. Then, it seems to be purposeful to make a reduction of the number of treatments with simultaneous preservation of the maximal efficiency of the experiment. A solution may be the application of fractional factorial designs of type s^{k-p} where p is a fraction of the whole pool of treatments. The objective of the study was to assess the usefulness of different full factorial, fractional and mixed designs in testing modified agrotechnical factors of a technology of crop production. In simulated studies the real data from the two 3^5 full factorial plot experiments were utilized. From the full factorial designs were simulated fractional factorial and mixed designs of type 3^{5-1}, $2^2 \times 3^3$ with resolution V as well as of type 3^{5-2}, 2^{5-1} and 2^{5-2} with resolution III. It was stated that from an economical point of view the most desired designs were the ones with a highly reduced number of treatments 3^{5-2} or 2^{5-1} i.e. with 27 and 16 treatments, respectively. At the same time with a higher reduction of treatments the experiment efficiency in detection of significant effects decreased. The utilization of additional information on spatial variability of available macronutrients in the soil (estimated by geostatistical methods) in the analysis of the results from such experiments increased the efficiency of the experiment.